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Vol. CI.] **[Part I.**

JOURNAL
OF THE ROYAL STATISTICAL SOCIETY
PART I, 1938.

PHYSICAL INDICES AND CLINICAL ASSESSMENTS OF THE NUTRITION OF SCHOOLCHILDREN

By R. HUWS JONES, M.A., B.Sc. (Econ.)

[Read before the ROYAL STATISTICAL SOCIETY, November 16, 1937, the President, the RT. HON. LORD KENNET OF THE DENE, P.C., G.B.E., D.S.O., D.S.C., in the Chair.]

MEN have always been interested in food, but of recent years that interest has taken a new direction and received fresh impetus. One sign of this increased interest is found in the place now given to nutrition in the Annual Reports of the Medical Officer to the Board of Education and the Ministry of Health. In Parliament, in the Press and on the Wireless, we have had discussions on the "marriage of health to agriculture." And this new concern in the problems of food is not confined to one country. The Assembly of the League of Nations, for example, has appointed a Technical Committee on Nutrition.

The Problem of Discovering Under-nourished Children

Recent circulars * issued by the Board of Education illustrate the importance attached to nutrition in official quarters. The experience of the Board has shown that in some areas there are children in need of supplementary nourishment who do not receive it. In the past, the selection of children for free meals and milk has largely been the responsibility of the teachers, but it is feared that persons without medical training may fail to detect early signs of subnormal nutrition. For this reason the Board strongly recommends the frequent examination by School Medical Officers of all children in public elementary schools.

It is reasonable and timely to insist that all children who need supplementary meals and milk should receive them. But how to discover which children are in need is an administrative problem of some difficulty.

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* Board of Education: Circulars 1437 and 1443 and Administrative Memorandum 124.

One solution proposed is that every child in every school should be thoroughly examined at frequent intervals by experienced physicians. At present children are seen by the School Medical Officer only three times during their school life, unless they are recommended by teachers or parents for special inspection. In order to have each child examined even yearly, it would be necessary almost to treble the present staffs of the School Medical Service, and yearly examination alone would not ensure the recognition of subnormal nutrition in its early stages. However desirable some may think this method to be, it must, for financial reasons, be ruled out as a practical solution for the near future.

An alternative method is to require School Medical Officers, when they are at a school for the routine examination, to "pass under rapid review all the children, and to select for detailed examination any children whose nutrition appears to be subnormal." According to this proposal, doctors enter the classroom of all children not due for routine examination, and, guided chiefly by facial appearance, but also by posture and general demeanour, select for examination those who appear to fall below a "reasonable standard of nutrition." No objective study appears to have been made in this country into the value of this procedure, but American researches have shown that of all the physical signs of under-nutrition the facial indications are the least reliable.* Doctors disagreed widely in their opinions concerning the same children, and pronounced facial signs of under-nutrition appeared so rarely as to be worthless as guides.

A third proposal is to employ some objective index, some physical measurement or combination of measurements, which will serve as a guide to the state of nutrition. Such an index would be employed as a screen or sieve for picking out those children who ought to be seen by a physician. It is desirable to make quite clear what this proposal amounts to. It is suggested that all the children in a given school population should be measured in certain selected characters which, either singly or in combination, could be used to identify children of unsatisfactory nutrition. The adoption of such an index is proposed primarily as an experiment in economy, an attempt to eliminate the expense involved in examining children of satisfactory nutrition. Children selected as unsatisfactory would immediately be given a special medical examination, for the purpose of an index is not to supplant but to supplement this part of the work of the School Medical Service.

Hundreds of physical indices of nutrition have been proposed by writers in many languages, but it is difficult to discover precisely what these indices will perform in practice. Though there is an enormous literature, there is no agreement among writers as to which index is best. General claims concerning the value of an index are met more frequently than precise details of performance, and few attempts have been made to test different indices on the same large group of children.

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* American Child Health Association (1929). *Physical Measures of Growth and Nutrition*, p. 7.

The Present Enquiry: Its Purpose and Methods

The Medical Department of the Liverpool Education Committee provided the writer with facilities for an enquiry into the relative efficiency of different indices of nutrition, in order to discover whether any index would prove of practical value in picking out the children required.

The choice of schools presented some difficulty. Routine examinations are a statutory requirement, but in a special enquiry of this kind the permission of the parents and the co-operation of the head-teachers are indispensable. It was therefore necessary to choose schools where the head-teachers and parents were willing to help. The enquiry caused them trouble and inconvenience, and their assistance, readily and generously given, is greatly appreciated. Although the 27 schools used in the enquiry do not constitute a random sample, they are scattered about every district of the city, and every type of day school under the Liverpool Education Committee is represented, with the exception of Roman Catholic non-provided schools, and the Art and Technical Schools.

The schools fall into four classes—Elementary, Central, Secondary and Special. The elementary schools are further sub-divided into Poor, Fair and Good. This sub-classification is based upon the occupational status of the fathers, the position of the border-line schools being determined by reference to the incidence of unemployment among the fathers and the judgment of officials familiar with the home conditions. Table I shows the definition of the three types of elementary schools, and Table II shows the number of schools included in the enquiry.

TABLE I

Classification of Elementary Schools

Elementary Schools	Proportion of Fathers Unskilled or Semi-skilled	Proportion of Fathers Professional, Clerical, etc.	Average Percentage of Fathers Unemployed
Poor	More than two-thirds	—	40
Fair	Less than two-thirds	Less than one-third	16
Good	—	More than one-third	6

TABLE II

Liverpool Schools

Schools	Elementary			Central	Secondary (Boys)	Special (M.D.'s)	Total
	Poor	Fair	Good				
Included in Enquiry...	7	5	6	5	3	1	27
Total in Liverpool ...	194			8	9	6	217

It was decided at first that the investigation should be confined to boys of three ages—6, 9, and 13, but later boys of intermediate ages were examined in poor elementary schools. By age 6, for example, is meant those who, at the date of inspection, were 6 and under 7 years of age.

The measurements were taken, and the medical examinations carried out, between January, 1935, and October, 1936, but 80 per cent. of the boys were examined in the spring of 1935.*

Within each school an attempt was made to examine every boy present who fell in the required age-groups. When this number was too large a sample was taken, each class contributing to the sample according to the proportion which the number of boys of a given age on its roll bore to the total number of these boys in the school. Coloured children were excluded from the enquiry, and the records of boys with marked deformities, such as pigeon chest and bow legs, were included only in the tables concerned with the distribution of boys in nutrition grades.

Before being measured, boys stripped to the waist, took off their shoes and emptied their trouser pockets of heavy articles. The measurements taken were : weight—to the nearest 0·05 kilogramme (kg.); height—to the nearest 0·25 centimetre (cm.); chest circumference and hip width—to the nearest 0·1 cm.

Weight and height were obtained with specially tested machines of the steel-yard type. Chest measurements were taken with an anthropometrical cloth tape. Steel sliding calipers were used to obtain the hip width, which was taken with the trousers slightly lowered. Each measurement was read at least twice, the second reading being taken after an interval during which other measurements were read. When differences appeared, the median measurement was adopted.

The medical examination was held as soon as possible after the measurements were taken, sometimes on the same day. In an at-

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* These figures apply to Liverpool only. As will be shown, the enquiry was extended to other areas after October, 1936.

TABLE III

Nutrition of Liverpool School Children according to Type of School and Age

Nutrition		Age 6						Age 9						Age 13											
		Good Elementary		Fair Elementary		Poor Elementary		Good Elementary		Fair Elementary		Poor Elementary		Good Elementary		Fair Elementary		Poor Elementary		Secondary		Central		Special	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Excellent	5	2	1·7	2	1·5	1	0·5	—	—	5	3·7	3	1·5	13	10·8	13	9·2	10	6·4	34	14·5	9	6·0	—	—
	4+	5	4·2	5	3·8	9	4·7	14	12·1	15	11·2	10	5·1	11	9·1	14	10·0	21	13·4	38	16·2	13	8·7	1	2·3
Normal	4	63	52·5	66	50·0	86	44·8	58	50·0	66	49·3	94	48·2	58	47·9	79	56·0	78	49·7	108	46·2	81	54·4	17	39·5
	3+	40	33·3	40	30·3	65	33·9	39	33·6	42	31·3	64	32·8	31	25·6	31	22·0	35	22·3	49	20·9	39	26·2	19	44·2
Sub-normal	3	9	7·5	14	10·6	28	14·6	5	4·3	5	3·7	19	9·8	7	5·8	4	2·8	11	7·0	5	2·1	6	4·0	5	11·6
	3−	—	—	5	3·8	3	1·6	—	—	1	0·7	4	2·1	1	0·8	—	—	2	1·3	—	—	1	0·7	1	2·3
Bad	2	1	0·8	—	—	—	—	—	—	—	—	1	0·5	—	—	—	—	—	—	—	—	—	—	—	—
	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Totals		120	100	132	100	192	100	116	100	134	100	195	100	121	100	141	100	157	100	234	100	149	100	43	100

tempt to ensure consistency, the entire medical survey was conducted by the same physician, an Assistant School Medical Officer chosen especially for this enquiry. Each child was stripped to the waist and given the usual routine examination of school children, except that hearing and vision were not tested. The following are among the clinical signs of nutrition noted: * general appearance, expression and colour; posture; amount of muscle and muscular tone; condition of the skin; condition of the mucous membranes; amount of subcutaneous fat; teeth; presence of any defect or deformity. In estimating the grade of nutrition, an effort was made to take no account of height or weight and to place no undue stress on any single sign or symptom. It was the general impression which influenced the physician. He had in his mind a picture of what he considered to be a normal healthy child. The physician was aware of, and thus was able to try to guard against, the danger of being influenced by the district or type of school, or by economic factors.

The nutrition of the children was classified under four main heads: 5—Excellent; 4—Normal; 3—Slightly Subnormal; 1 and 2—Bad. Since difficulty was sometimes experienced in deciding on certain cases, which appeared to be on the border-line between adjacent groups, additional classes were formed by the use of + and — signs. Thus, for example, if a child's nutrition was considered to be somewhat worse than "slightly subnormal" and yet not definitely "bad," the symbol 3— was adopted.

Table III shows the distribution of nutrition according to age and type of school in the first survey.

The second medical examination was begun six months after the first had ended, and was confined to boys aged 7, 8, and 12 in the same poor elementary schools. The distribution of nutrition is shown in Table IV.

TABLE IV

Nutrition of Boys in Poor Schools according to Age

Nutrition.	Age 7		Age 8		Age 12	
	No.	%	No.	%	No.	%
5	—	—	3	3·0	2	1·5
4+	6	5·6	5	5·0	6	4·4
4	51	47·4	48	47·5	67	49·4
3+	32	29·6	28	27·7	38	28·0
3	17	15·8	13	12·8	20	14·7
3—, 2 and 1 ...	2	1·8	4	4·0	3	2·2
Totals	108	100	101	100	136	100

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* The School Medical Officer kindly provided a note of the material contained in this and the following paragraphs.

A comparison between Tables III and IV suggests that a deterioration in the nutrition of the children had taken place in the six months' interval. For example, there was at age 12 a significantly higher proportion of ill-nourished children and a smaller proportion of excellently nourished children than was found six months previously at age 13 in the same schools. The tendency for nutrition to improve with age, apparent in Table III, was not maintained. The physician who made both medical surveys, the Chief Assistant and the Senior School Medical Officers were convinced that there had been no such increase in the proportion of ill-nourished children as the figures suggested. In fact, it was believed that the extension of facilities for the provision of free meals and milk had improved the state of nutrition and, in particular, had reduced the proportion of ill-nourished children.

If the figures in Table IV are invalid, or inconsistent with Table III, it is necessary to enquire into the reasons for the inaccuracy. It is possible that the physician's own standard, his mental picture of the well-nourished boy, had changed, so that on the second occasion he ranked as ill-nourished, boys whom previously he would have considered satisfactory. An alternative explanation may be the fact that the classification of nutrition used in routine examinations was altered between the end of the first nutrition survey and the beginning of the second. Although the school medical officer re-adopted the old classification and strove to keep to it, recent habit may have proved too strong and influenced his ratings. The question of the reliability and consistency of clinical assessment is hereby raised, and will be discussed later.

The Physical Measurements of Boys in Different Types of School

In the course of the enquiry certain physical measurements were obtained for over 2,000 Liverpool school boys. These make comparisons possible between different types of school and different grades of nutrition.*

Table V shows that differences in physical measurements, consistent and usually significant, though sometimes small, are found between the different types of school. On the average, boys are about 5† per cent. heavier in good elementary than in poor elementary schools. At age 13 boys in secondary schools are on the average about 15 per cent. heavier than boys in poor elementary schools. The same tendency holds good with height. Boys in good elementary schools are on the average about 4 per cent. taller (as compared with 5 per cent. heavier) than boys in poor elementary schools. The average height of boys of age 13 in secondary schools exceeds that of boys of the same age in poor elementary schools by 6 per cent. In chest girth, however, the differences between the different types of school are, in the age-groups 6 and 9, very small and not significant. In the age-group 13 the average chest girth in secondary schools is about 3 per cent. greater than in poor elementary schools. The superiority of the socially better type of school is most evident in weight, next in height, and least in chest girth.

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* In the interest of space the Basic Tables have been omitted, but copies of all Tables relevant to the discussion are lodged with the Royal Statistical Society and with the Social Science Department (Statistics Division), University of Liverpool, for the benefit of interested persons.

† In this paper, when the difference between two numbers is expressed as a percentage, unless otherwise stated, it is a percentage of the smaller number.

TABLE V

Differences between Mean Physical Measurements of Boys in Different Types of School

Types of School		Weight (kgs.)	Height (cms.)	Deflated Chest (cms.)
Age 6	Fair less Poor	0·72 ± 0·19*	2·63 ± 0·42	0·6 ± 0·2
	Good less Fair	0·40 ± 0·22	1·93 ± 0·45	–0·5 ± 0·2
	Good less Poor	1·12 ± 0·19	4·56 ± 0·42	0·2 ± 0·2
Age 9	Fair less Poor	1·01 ± 0·25	2·64 ± 0·47	0·4 ± 0·2
	Good less Fair	0·31 ± 0·26	2·24 ± 0·50	0·0 ± 0·3
	Good less Poor	1·32 ± 0·25	4·88 ± 0·47	0·4 ± 0·2
Age 13	Fair less Poor	2·62 ± 0·51	4·48 ± 0·64	1·3 ± 0·3
	Good less Fair	–0·76 ± 0·55	0·28 ± 0·64	–0·1 ± 0·4
	Good less Poor	1·86 ± 0·49	4·76 ± 0·62	1·3 ± 0·3
	Central less Good	0·44 ± 0·52	0·24 ± 0·62	–0·5 ± 0·4
	Secondary less Good	3·92 ± 0·49	3·96 ± 0·56	0·5 ± 0·3
	Secondary less Poor	5·78 ± 0·45	8·72 ± 0·56	1·8 ± 0·3

* Throughout this paper, the number following the ± sign is the probable error of the preceding statistical constant.

It will be shown later that on the average boys in lower grades of nutrition have smaller physical measurements than boys in higher grades. It might therefore be supposed that the whole of the differences in height and weight between poorer and better schools could be explained by differences in the distribution of nutrition. In fact, however, we find that boys placed by the physician in the same grade of nutrition differ in average height and weight from one type of school to another. For example, it will be seen from Table VI that boys of nutrition 4, officially described as "normal," are at all ages concerned heavier and taller in the better type of school. Boys age 13 in secondary schools are 4·30 kgs.—*i.e.* 12 per cent.—heavier, and 7·66 cms.—*i.e.* 5 per cent.—taller, than boys of the same age and grade of nutrition in poor elementary schools.

TABLE VI

Differences between Mean Physical Measurements of Boys of " Normal " Nutrition in Different Types of School

Types of School		Weight (kgs.)	Height (cms.)
Age 6	Fair less Poor	1·11 ± 0·22	3·60 ± 0·54
	Good less Fair	0·11 ± 0·25	1·49 ± 0·53
	Good less Poor	1·22 ± 0·20	5·09 ± 0·54
Age 9	Fair less Poor	0·67 ± 0·27	2·42 ± 0·61
	Good less Fair	0·31 ± 0·27	2·29 ± 0·76
	Good less Poor	0·98 ± 0·27	4·71 ± 0·65
Age 13	Fair less Poor	2·25 ± 0·43	4·64 ± 0·67
	Good less Fair	0·26 ± 0·45	1·60 ± 0·72
	Good less Poor	2·51 ± 0·43	6·24 ± 0·72
	Central less Good	0·17 ± 0·43	−1·05 ± 0·69
	Secondary less Good	1·79 ± 0·43	1·42 ± 0·69
	Secondary less Poor	4·30 ± 0·40	7·66 ± 0·64

It appears that even if the distribution of nutrition in the poorer schools were raised to the same standard as in the better schools, differences in height and weight would remain. The meaning of these differences is not clear. It may be that the doctor's concept of the " normal " boy differs from one type of school to another, or it may be that hereditary factors, correlated with social class, are at work, so that the differences which at present exist are not due entirely to differences of environment or nurture. But the experiments of Corry Mann, McCarrison and others justify the belief that some, at least, of the existing differences in physical measurements would disappear if boys in the poorer schools were supplied with those elements in which their diets are deficient. Though boys in poor schools are lighter and shorter, yet they have much the same chest girths as boys of the same age in better schools. The comparative superiority in the ratio of chest to height of boys in poor schools calls for comment. There may perhaps be some explanation for this in terms of known differences in the effect of food deficiencies on the various aspects of growth. Again, it has been suggested that poorer boys, playing and shouting more freely in the streets, tend to develop their chests more than more carefully nurtured children. In the opinion of certain German writers, the comparatively large chest girth of poor boys is an advantage.* They consider that a gain in weight and height, without a corresponding gain in chest girth, should be deplored, like the long unhealthy shoots of certain "hot-house plants." On the other hand, it has been maintained that weight should increase in proportion to the frame of the body; if that is so, then the relatively large chest girth of poor boys must be deemed a disadvantage, for it lowers the ratio of weight to chest in boys already light for their height and age.

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* M. Pfaundler: "Korpermass—Studien an Kindern," *Ztscht. f. Kinder,* 1916, **14,** 1.

The Physical Measurements in Boys of Different Grades of Nutrition

The differences in weight between boys in different grades of nutrition, at ages 6, 9, and 13, are shown in Table VII. It will be seen that boys in superior grades of nutrition weigh considerably more than boys in inferior grades. On the average, boys of excellent nutrition are more than 25 per cent. heavier, and boys of normal nutrition are more than 12 per cent. heavier, than boys of unsatisfactory nutrition.

TABLE VII

Differences between Mean Weight (in kgs.) of Boys in Different Grades of Nutrition

Schools		(5 and 4+) less 4	4 less 3+	3+ less (3 and 3−)
Age 6 Poor ...		3·78* P <0·01	1·29 ± 0·19	1·27 ± 0·28
Age 6 Fair ...		3·43 P <0·01	2·14 ± 0·26	1·92 ± 0·32
Age 6 Good ...		3·73 P <0·01	1·91 ± 0·26	2·12 P <0·01
Age 9 Poor ...		5·59 ± 0·29	1·93 ± 0·27	2·33 ± 0·43
Age 9 Fair ...		3·71 ± 0·39	2·57 ± 0·29	1·35 P =0·1
Age 9 Good ...		2·94 ± 0·83	1·84 ± 0·34	1·88 P =0·05
	5 less 4+	4+ less 4	4 less 3+	3+ less (3 and 3−)
Age 13 Poor ...	9·49 ± 1·12	4·56 ± 0·59	3·76 ± 0·45	3·87 ± 0·70
Age 13 Fair ...	9·21 ± 1·92	4·89 ± 0·71	5·20 ± 0·55	3·40 P <0·01
Age 13 Good ...	3·49 ± 1·27	5·20 ± 0·70	5·61 ± 0·41	2·92 ± 0·60
Age 13 Central ...	8·11 ± 1·90	7·44 ± 0·80	5·43 ± 0·49	2·90 ± 0·80
Age 13 Secondary	8·17 ± 0·86	4·95 ± 0·52	4·15 ± 0·49	3·40 P =0·05

* When one of the samples is small, the "t" test has been applied to determine the significance of the difference between the means. The nearest P is given except when it is greater than 0·9 or less than 0·01, and then the fact is indicated.

Similarly with height, constant and usually significant differences distinguish boys in different grades of nutrition. To illustrate, Table VIII shows that in poor schools the difference between the average height of boys of the best and worst grades of nutrition amounts to

9 cms. (or 8 per cent.) at age 6, to 13 cms. (or 11 per cent.) at age 9, and to 24 cms. (or 18 per cent.) at age 13.

Table VIII

Differences between Mean Height (in cms.) of Boys in Different Grades of Nutrition

Schools			(5 and 4+) less 4	4 less 3+	3+ less (3 and 3−)
Age 6	Poor ...		6·50 P <0·01	1·05 ± 0·57	1·62 ± 0·71
	Fair ...		3·89 P =0·1	2·55 ± 0·59	3·34 ± 0·88
	Good ...		3·75 P =0·05	2·11 ± 0·67	3·65 P =0·05
Age 9	Poor ...		8·81 ± 0·65	0·94 ± 0·64	3·63 ± 1·2
	Fair ...		5·77 ± 0·78	2·31 ± 0·71	−2·03 P =0·3
	Good ...		3·54 ± 0·87	0·70 ± 0·75	1·47 P =0·5
		5 less 4+	4 + less 4	4 less 3+	3 + less (3 and 3 −)
Age 13	Poor ...	9·30 ± 1·39	5·67 ± 0·84	2·88 ± 0·91	6·08 ± 1·56
	Fair ...	7·82 ± 2·02	3·67 ± 1·23	4·64 ± 1·07	1·14 P >0·9
	Good ...	1·44 P >0·9	3·07 ± 1·26	5·70 ± 0·84	1·12 ± 1·72
	Central ...	3·11 ± 2·01	9·25 ± 1·38	4·01 ± 0·90	1·22 ± 1·26
	Secondary	4·47 ± 1·14	4·51 ± 0·87	2·19 ± 0·85	2·00 P =0·2

Similar results emerge from an examination of differences in chest measurements (Table IX). With no exception the superior grades of nutrition have greater average chest girths than the lower grades, and the differences are usually considerable. For example, in the age-group 13, we find in every type of school that the highest

Table IX

Differences between Mean Deflated Chest Girths (in cms.) of Boys in Different Grades of Nutrition

Schools			(5 and 4+) less 4	4 less 3+	3+ less (3 and 3−)
Age 6	Poor		2·8 P <0·01	1·6 ± 0·2	1·5 ± 0·3
	Fair		3·6 P <0·01	1·6 ± 0·3	2·4 ± 0·4
	Good		4·0 P <0·01	1·7 ± 0·3	1·5 P =0·2
Age 9	Poor		3·8 ± 0·3	1·9 ± 0·2	1·7 ± 0·8
	Fair		3·1 ± 0·4	1·6 ± 0·3	2·9 P <0·01
	Good		2·4 ± 0·4	1·9 ± 0·4	1·5 P =0·1
		5 less 4+	4 + less 4	4 less 3+	3 + less (3 and 3 −)
Age 13	Poor	5·4 ± 0·7	2·9 ± 0·3	2·6 ± 0·3	2·5 ± 0·4
	Fair	4·3 ± 0·8	4·2 ± 0·5	3·5 ± 0·4	3·3 P <0·01
	Good	2·9 ± 0·7	3·9 ± 0·4	3·6 ± 0·4	2·9 ± 0·8
	Central	6·4 ± 1·1	3·8 ± 0·5	4·1 ± 0·3	0·7 P =0·6
	Secondary ...	4·9 ± 0·5	3·5 ± 0·3	3·3 ± 0·3	2·6 P =0·05

grade of nutrition has an average chest measurement more than 20 per cent. greater than the measurement in the lowest grade. Thus, though differences in chest measurements fail to distinguish between social classes, they do distinguish between different grades of nutrition.

The various grades of nutrition are distinguished not merely by differences in physical measurements, but also by differences in the ratios between them. Boys who are judged by the doctor to be better nourished are, on the average, heavier for their height and for their chest girth than boys who are judged to be less well nourished. The ratio of chest girth to height does not appear to distinguish grades of nutrition so effectively.

The measurements of the age-groups 7, 8, and 12 were taken from poor elementary schools only, in the second nutrition survey. The tables showing the differences between the mean physical measurements of boys in different grades of nutrition for these age-groups are omitted to save space. Reasons have been offered for doubting whether the classification into nutrition grades in the second survey is consistent with the classification made previously. It is therefore interesting to note in these age-groups that the tendency for boys in the higher grades of nutrition to have larger physical measurements is neither so clear nor so constant as in Tables VII–IX, though it is still evident, and apparent in the two new measures introduced (chest inflated and hip width).

From this analysis of the relation of physical measurements to nutritional status it is clear that boys said by the School Medical Officer to be well nourished are on the average heavier, and larger in their skeletal measurements, than those described as of unsatisfactory nutrition. Nutrition grades are distinguished best by weight, then by chest, and finally by height. Furthermore, the ratios of weight to height and weight to chest are considerably higher in superior grades of nutrition. The fact that the physician's judgment of the state of nutrition is associated in this way with these objective physical measurements justifies the hope that they may prove useful for the purpose of picking out for more detailed examination the kind of children a doctor would describe as ill-nourished.

Indices of Nutrition Compared

The Medical Department of the Liverpool Education Committee desired an index to select for examination the type of boy who, in our enquiry, had been placed in Grade 3 or below, adding that if those boys in Grade 3+ who appeared nearest to Grade 3 were selected also, this would not be a disadvantage. It should be noted that the School Medical Officer's assessment of the state of nutrition is for the time being accepted as the standard by which indices may be compared.

The ideal index selects all the boys required, and no others. The less efficient index selects, in addition to these, boys whose medical examination is an unnecessary labour and expense. But if the index which excludes all boys not required involves much time and trouble, and if it necessitates the services of highly paid technicians, it may prove more expensive than less efficient indices. The simplicity of an index and the time necessary to apply it are of great practical importance. In fact, it appeared, from opinions expressed by School Medical administrators, and from discussions in the literature, that no index, however efficient, would be widely used by school authorities unless it satisfied the following conditions :

1. The measurements required should be sufficiently straightforward to be made accurately by school nurses in routine visits.
2. The calculations involved should be few and easy—preferably the results should be obtained by reference to a simple table.
3. The whole process should be so speedy that it could be applied to a large school population without serious alteration in the existing staff or organisation.

It was decided to test and compare every index of which a record could be traced, together with several believed to be new, provided they satisfied the above conditions. Many indices had to be rejected because they appeared too difficult to apply, too complex, or too time-consuming, for use in routine visits.

Indices are sometimes compared by calculating their correlation with a doctor's judgment. A coefficient of correlation, however, provides a measure of the *general* association of an index with clinical assessment, whereas practical interest is directed on the particular boys whom it is desired to screen. In order to compare efficiency in screening, the following tests were applied :

1. The first test was an attempt to answer the question : If we apply an index to a group of boys, how many must be screened for examination to ensure the selection of every boy in Grade 3 or below ? In other words, how many boys are there in the whole group with indices equal to or below the highest index among the boys required for examination ? Obviously, the more efficient the index, the smaller will be the total number of boys screened to ensure the selection of every boy required. This test may, of course, be modified by requiring an index to screen, not all the boys in Grade 3 or below, but a given proportion of them—perhaps 80 per cent. It should be noted that the percentage of boys which must be screened to satisfy this test may be expected to increase with the size of the sample.

2. The second test was an attempt to answer the question: If a group of boys were arranged in order of nutrition according to a particular index, and the lowest 30 per cent.* examined, as theoretically the least well-nourished, how many boys of nutrition Grade 3 or below should we find among them? The more efficient the index the greater will be the number of ill-nourished boys included.

These tests give no absolute scale of efficiency, but they do provide a fair comparison of different indices calculated for the same sample.

The preliminary comparison of indices was attempted on a group of 183 boys age 9 in poor elementary schools, 21 of whom were in Grade 3 or below. The results are presented in Table X. Column 3 shows the correlation of each index with the clinical assessment of

TABLE X

Performance of Indices of Nutrition when Applied to 183 *Boys age* 9 *in Poor Schools.* 21 *Boys are Medically Described as Ill-nourished*

(1) Index. Brief Description	(2) Sources	(3) Correlation	(4) Boys Screened to Secure Every Ill-nourished Boy		(5) Ill-nourished Boys among Lowest 30% of Group	
			No.	%	No.	%
W/H	Quetelet, etc.	0·75	90	49·0	17	81·0*
(W/H) × (381 − months)/54	Tuxford	0·82	98	53·5	18	86·0
Ht. × 0·455 = Wt. (†)	Van Noorden	0·73	97	53·0	17	81·0
Ht. × 0·214 = Wt. (†, ‡)	—	—	87	47·5	18	86·0
Wt. for Ht. (†)	Baldwin—Wood table	0·56	140	76·5	17	81·0
Wt. for Ht. (†, §)	—	0·75	81	44·5	19	90·5
Wt. for Ht. and Age (†, §, ‖)	—	—	66	36·0	19	90·5
W/H^2	Quetelet, etc.	0·63	80	44·0	18	86·0
$W/H^{2\frac{1}{2}}$	Quetelet, etc.	0·56	153	84·0	15	71·5
W/H^3	Buffon, etc.	0·29	177	97·0	12	57·0
H^3/W	Bobbit	−0·31	177	97·0	12	57·0
$\sqrt[3]{W}/H$	Livi	0·35	168	92·0	13	62·0
W/C	—	0·60	164	90·0	14	67·0
W/HC^2	—	0·16	170	93·0	7	33·5
W/HC	—	0·65	125	68·5	17	81·0
HC/240 = Wt. (†)	Bornhardt	0·66	146	80·0	19	90·5
HC/294 = Wt. (†, ‡)	—	—	130	71·0	17	81·0
Wt. for Ht. and Chest (†, §)	—	0·54	116	63·5	17	81·0
Wt. for HC^2 (†, §)	—	0·55	175	95·5	16	76·0
Wt. for Chest (†, §)	—	0·56	171	95·0	14	67·0
Ht. − 100 = Wt. (†)	Broca	—	182	100·0	7	33·5
C/H	Bruysch	0·19	180	98·5	10	47·5
H − (W + C)	Pignet	−0·35	176	96·0	11	52·0
Weight	"Poverty, Nutrition and Growth"	0·54	132	72·0	16	76·0
Height	—	0·33	168	92·0	12	57·0
Chest	—	0·51	159	87·0	16	76·0

(*) The number in the previous column is here expressed as a percentage of 21, *i.e.* of all the ill-nourished boys.

(†) A weight prediction formula. The index is the percentage deviation of the observed from the predicted weight.

(‡) This is the previous index presented in a form better suited to the present group.

(§) A regression formula obtained from "normally" nourished boys in the group.

(‖) In this index allowance is made for age in months.

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* Inspection showed this to be the most convenient percentage to adopt.

nutrition.* Column 4 gives the number and percentage of the whole group which must be screened to secure every boy in Grade 3 or below—called "ill-nourished boys"; the smaller the number in this column the better the result. Column 5 gives the number and percentage of boys of Grade 3 or below who are included among the lowest 55 boys—30 per cent. of 183; in this column the larger the number the better the result.

While a single good performance is no proof of the value of an index, a single poor performance is sufficient to justify its elimination. The following list distinguishes those indices which, according to Table X, merited further testing, from those which showed little promise. But the decision as to whether an index deserved further trial was influenced not only by its performance, but also by its simplicity and ease of application.

Indices considered worthy of further testing :

W/H
$(W/H) \times (381 - \text{Age in Months})/54$
Ht. × Constant = Wt.
Wt. for Ht.
Wt. for Ht. and Age
W/H^2
$W/H^{2\frac{1}{2}}$
Wt. for Ht. and Chest
W/HC
$HC/\text{Constant} = \text{Wt.}$
Weight

Indices not considered worthy of further testing :

W/H^3
H^3/W
$\sqrt[3]{W}/H$
Wt. for Chest
W/HC^2
Wt. for HC^2
C/H
W/C
$H - (W + C)$
Ht. − 100 = Wt.
Height
Chest

Tables XI and XII summarize the performance of the most promising indices. One new index is introduced, namely, weight for height and hip.† Inspection showed that in every group with every index there were a few boys in Grade 3 with indices considerably above their fellows. In order to allow for these "freaks" it was decided to aim at securing 80 per cent., instead of 100 per cent. of the boys in Grade 3. Indices have been tested chiefly in poor schools; one reason for this is that only there was the number of boys of subnormal nutrition sufficient to justify statistical treatment. Moreover, the differences in the physical measurements of boys in different types of school suggested the advisability of considering each type separately.

Tables XI and XII show that those indices which involve chest or hip measurements do not excel in their performance those based on weight and height alone. The indices which agree most closely with

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* The product moment method, with nutrition classified 1, 2, 3, 4, 5, 6, has been adopted throughout this enquiry for the correlation of clinical assessments of nutrition.

† H. B. Pryor and H. R. Stoltz, "Determining Appropriate Weight for Body Build," *Journal of Pediatrics*, 1933, 3, 608.

TABLE XI

Performance of Indices of Nutrition

Index	Percentage of Group Screened to Secure 80% Ill-nourished Boys					
	Age-group					
	6	7	8	9	12	13
Weight	49·5	64·0	23·5	39·5	40·5	8·5
W/H	44·0	41·0	23·5	23·5	31·0	10·0
W/H^2	33·0	38·5	21·5	22·5	31·0	18·0
$W/H^{2\frac{1}{2}}$	—	34·5	24·5	41·5	—	—
Ht. × Constant = Wt.	—	45·0	24·5	22·0	31·0	9·0
Wt. for Ht.	33·5	43·5	21·5	23·0	31·0	23·5
Wt. for Ht. and Age	—	—	—	22·0	30·5	—
(W/H) × (381 — months)/54	32·0	37·0	28·0	24·5	29·0	10·5
W/HC	—	—	—	28·0	48·0	—
HC/Constant = Wt.	44·0	59·0	29·0	23·0	48·0	18·0
Wt. for Ht. and Ch.	—	—	—	35·5	60·5	—
Wt. for Ht. and Hip *	—	40·0	29·0	—	42·5	—
Wt. for Ht. and Ch.	—	26·0	33·0	—	60·5	—
Wt. for Ht.	—	36·0	31·0	—	31·0	—
(W/H) × (381 — months)/54	—	27·0	32·0	—	29·0	—

* The hip measurements were not obtained for some boys; the " Wt. for Ht. and Hip " index had therefore to be applied to groups rather smaller than the whole age groups concerned. The three following indices also were applied to these sub-groups to ensure a fair comparison.

TABLE XII

Performance of Indices of Nutrition

Index	Ill-nourished Boys among Lowest 30% of Group as Percentage of All the Ill-nourished Boys in the Group					
	Age-group					
	6	7	8	9	12	13
Weight	66·5	59·0	76·5	76·0	61·0	90·0
W/H	77·0	65·0	76·5	81·0	74·0	90·0
W/H^2	73·5	65·0	94·0	86·0	74·0	85·0
$W/H^{2\frac{1}{2}}$	—	65·0	82·5	71·5	—	—
Ht. × Constant = Wt.	—	65·0	82·5	86·0	74·0	90·0
Wt. for Ht.	77·0	65·0	94·0	90·5	74·0	77·0
Wt. for Ht. and Age	—	—	—	90·5	78·0	—
(W/H) × (381 — months)/54	77·0	70·5	82·5	86·0	82·5	90·0
W/HC	—	—	—	81·0	65·0	—
HC/Constant = Wt.	60·0	59·0	76·5	81·0	65·5	90·0
Wt. for Ht. and Ch.	—	—	—	81·0	39·0	—
Wt. for Ht. and Hip *	—	70·0	81·0	—	60·5	—
Wt. for Ht. and Ch.	—	80·0	75·0	—	39·0	—
Wt. for Ht.	—	70·0	75·0	—	74·0	—
(W/H) × (381 — months)/54	—	80·0	75·0	—	82·5	—

* See footnote to Table XI.

the physician's estimate are those which relate weight to height directly. If age to the nearest month is taken into account, such indices may be improved, but raising height to some higher power appears to be an unnecessary and sometimes harmful refinement. On the whole, Tuxford's index *

$$(W/H) \times (381 - \text{age in months})/54$$

gives the best performance. The slight superiority of this index over the " weight for height " index, which rests on the same theoretical basis, is due to the fact that it makes a finer allowance for age. A similar allowance could be made in the ordinary weight for height index if it appeared more convenient in practice than Tuxford's index.

Tuxford's Index

Tuxford's index must now be compared, from the point of view of expediency, with the weight for height index. It should be noted that neither of these indices involves any addition to the measurements usually recorded by school authorities.

For the construction of tables showing " appropriate " or average weight for height and age, it would be necessary to take the measurements of a large sample of children of satisfactory nutrition within the area concerned. It would also be necessary to determine the precise departure from appropriate weight which is most efficient in picking out children of the required grades of nutrition. Tables could then be prepared showing the minimum number of kilogrammes which a child of a given height and age should weigh. Any child whose weight fell below this minimum would be referred to the School Medical Officer for examination. This table would tell merely whether a child was below or above the " minimum " weight for his height and age. If the exact degree of departure from the average were required, the difference between the observed and average weight would, in every case, have to be expressed as a percentage of the average weight.

Tables showing Tuxford's index for each height, weight, and month of school age could be prepared without the trouble of preliminary measurements, and this would mean a great economy. Tuxford's index, which may be described as a " nutrition quotient," is about 1,000 for average children. As nutrition falls below average the index diminishes. It would be necessary to determine the least departure from the average which would pick out a sufficiently large proportion of boys in the required grades of nutrition. Tuxford's index has the advantage of showing at a glance the extent to which a child departs from average because every index is related to the same base—1,000.

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* A. W. Tuxford: " A Measure of Physical Development in School Children," *School Hygiene*, 1917, 8, 656. The above is the index for boys only, and the measurements are expressed in the metric system. Dr. Tuxford has suggested the following adaptation for English measures: (lbs./inches) × (379 — age in months)/0·3.

The experiment has been tried of fixing the lower limit of the "normal" zone at 970. Every boy whose index was 970 or below was selected, and in this way 32 per cent. of all boys examined in poor schools were screened. These included 8 out of 10 of the boys described by the School Medical Officer as of nutrition 3 or below; nearly half of those of nutrition 3+ and 13 per cent. of those of nutrition 4. Detailed results are shown in Table XIII.

TABLE XIII

Performance of Tuxford's Index when All Boys with Indices of 970 *or Under are Screened. Poor Schools Only. All Ages.*

Nutrition	No. of Boys	No. Screened	Percentage Screened
3 and 3—	121	99	82·0
3+	251	122	48·5
4	410	54	13·0
4+ and 5	76	—	—
All	858	275	32·0

The total screened is 275. Of these boys 99 or 36 per cent. are in Grade 3 or under; 122 or 44·5 per cent. are in Grade 3+, and 54 or 19·5 per cent. are in Grade 4. None are in Grades 4+ or 5. The results of the application of Tuxford's index to boys age 6 in fair and good elementary schools closely resemble those at the same age in poor schools.

The Variability of Clinical Assessments of Nutrition

It was thought desirable to enquire into the variability of School Medical Officers in their assessments of nutrition, and to discover how far the doctor who assisted in this investigation was representative of his colleagues in his judgments.

A circular was sent to the parents of some 350 boys in two schools in a poor district, asking whether they would be willing for their sons to attend school for an hour during the school holidays, for a special medical examination. Favourable replies were obtained from about 170 parents, and 142 boys actually attended for the examination.

The Medical Department of the Liverpool Education Committee provided four experienced male members of its staff to take part in the enquiry, one (Dr. 1) being the physician who had conducted the two medical surveys already described. The doctors were requested to assess nutrition precisely as they would in an ordinary routine examination. In order to avoid accidental slips, they decided to keep to the notation then used in routine examinations. The results are first set out in this notation and later translated into the notation recommended by the Board of Education. Before the examination began the doctors discussed other points of procedure and definition, such as the grade of nutrition in which the 'thin, wiry' type of boy should be placed.

Table XIV shows that, in the opinion of one doctor, 17 boys among the 142 are of excellent nutrition, though another finds 1 only. If a doctor places a boy in Grade 3 or below, it may be presumed that he considers him to be subnormally nourished beyond doubt. One doctor finds 8 such boys, and another finds 23, or nearly three times as many. Again, one doctor regards 24 boys, or 17 per cent., as subnormally nourished in some degree, while another finds 38, or 27 per cent. It is evident that the distribution of nutrition found in a given population, and in particular the amount of subnormal nutrition reported, may differ considerably according to the doctor who makes the examination.

TABLE XIV

Distribution of Nutrition according to Different Doctors

Nutrition		Doctor			
		1	2	3	4
Excellent	5	1	—	5	—
	4+	5	11	12	1
Normal	4	86	82	89	83
	4−	24	20	12	20
Subnormal	3+	18	6	14	23
	3	7	22	9	10
Bad	3−	1	1	1	—
	2+	—	—	—	5
Totals		142	142	142	142

Table XIV does not provide an adequate measure of the agreement among doctors, because it does not tell how far they agree in placing *the same boys* in any given grade of nutrition. The correlations between the doctors have been calculated and are shown in Table XV.* They range from 0·58 to 0·67 and the median correlation is between 0·62 and 0·64. The extent of the difference of opinion among the four doctors is illustrated in Table XVI. There was complete agreement on 48 of the 142 cases. It is noteworthy that 47 of these were in Grade 4—that is, of normal nutrition. Medical opinion was unanimous concerning scarcely any but boys of normal nutrition. In 12 cases there are differences of 3 grades or more and one difference of 5 grades appears.

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* See footnote on page 15.

TABLE XV

Correlation between Doctors

Doctor	Doctor 1	2	3	4
1	—	0·64	0·58	0·64
2	0·64	—	0·62	0·67
3	0·58	0·62	—	0·60
4	0·64	0·67	0·60	—

TABLE XVI

Differences between Doctors' Assessments

Maximum Difference	No. of Boys	Percentage
None	48	33·8
1 Grade	41	28·9
2 Grades	41	28·9
3 Grades	10	7·0
4 Grades	1	0·7
5 Grades	1	0·7
Totals	142	100

Differences of opinion among medical men are of greatest practical importance when they concern boys in the lower grades of nutrition. Table XVII shows that of the 30 boys placed in Grade 3 or below by one or more of the doctors, only 3 are there by agreement among the four. Fifteen boys are placed in Grade 3 or below by one doctor and in a higher grade by the other three. Again, out of 55 boys in Grade 3+ or below according to the opinion of one doctor or another, only 8 are there by a unanimous verdict. It will be seen that there are 22 boys who are considered to be subnormal by one doctor and normal or above by the other three.

The assessments of nutrition have been arranged in accordance with the classification recommended by the Board of Education. The resulting distributions are shown in Table XVIII, and the amount of agreement among the doctors is shown in Tables XIX and XX.

There is, of course, more agreement when four, instead of eight, grades of nutrition are recognized, because there is less room for

Table XVII

Agreement among Doctors on Boys Assessed Subnormal

No. of Doctors Giving the Assessment	No. of Boys Placed in Grade 3 or Below	No. of Boys Placed in Grade 3 + or Below
All	3	8
3 only	5	13
2 only	7	12
1 only	15	22
Totals	30	55

Table XVIII

Distribution of Nutrition according to Different Doctors

Grade of Nutrition	1	2	3	4
A—Excellent	6	11	17	1
B—Normal	110	102	101	103
C—Slightly Subnormal ...	25	28	23	33
D—Bad	1	1	1	5
Totals	142	142	142	142

Table XIX

Agreement among Doctors within each Grade of Nutrition

Grade of Nutrition	Number of Boys Placed in Given Grade by			
	All 4 Drs.	3 Drs. only	2 Drs. only	1 Dr. only
A	1	3	5	12
B	67	32	18	16
C	5	13	13	24
D	—	—	2	4
Totals	73	48	38	56

Number of boys placed in same grade by :

4 Doctors	73
3 Doctors	48
2 Doctors (the other 2 agreeing with each other)	17
2 Doctors (the other 2 disagreeing with each other)	4
	142

TABLE XX

Degree of Difference among Doctors

Maximum Difference	No. of Boys	Percentage
None	73	51·4
1 Grade	65	45·8
2 Grades	4	2·8
Totals	142	100

disagreement. Table XIX shows that the four medical men are in agreement concerning 73 boys, of whom only 5 are of subnormal nutrition. In 56 cases, doctors give opinions which are not confirmed by any of their colleagues. As will be seen from Table XX, in 69 cases there is a difference of opinion of one grade or more; with the coarser classification here adopted, this is a serious matter, for it means that often one doctor will assess as normal boys who would be regarded as subnormal by others. Differences of two grades occur in four instances; that is to say, it is possible for one doctor to find a boy excellently nourished, while another describes him as subnormal; and for one doctor to report a boy as badly nourished while another considers him to be normal.

If, ignoring all finer distinctions, we differentiate only between those boys who are satisfactory (Grades A and B) and those who are unsatisfactory (Grades C and D) we find that doctors agree as to whether a boy is satisfactory or not in 95 cases or 67 per cent. and disagree in 47 cases or 33 per cent.

Fifty-five boys are placed in Grades C or D by one or other of the doctors. One of the doctors, however, finds only 24 boys, and no doctor alone finds more than 38 boys, in these grades. In other words, the aggregate number of boys found to be subnormally nourished by one doctor or another is from 45 to 130 per cent. higher than the number discovered by any doctor alone.

The agreement between Tuxford's index and the clinical assessments may next be considered. The correlation between each doctor's judgment and the index is as follows: *

	Dr. 1.	Dr. 2.	Dr. 3.	Dr. 4.
Correlation with Tuxford's index	0·53	0·50	0·56	0·40

It will be seen that these medical men agree with one another more closely than with the index. There are 43 boys, or 30 per cent. of the total, with an index of 970 or lower. These include 20 out of the 30 boys who are in Grade 3 or below according to the opinion of at least one doctor. The index screens:

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* See footnote on page 15.

6 out of the 8 boys placed in Grade 3 or below by Dr. 1.
15 ,, 23 ,, ,, ,, ,, ,, Dr. 2.
9 ,, 10 ,, ,, ,, ,, ,, Dr. 3.
11 ,, 15 ,, ,, ,, ,, ,, Dr. 4.

In Table XXI each doctor in turn is taken as "Standard," and the number of boys whom he considers to be subnormal is shown in italics. The remaining columns show how many of these boys are found subnormal by each of the other doctors and by the index. In 8 out of the 12 comparisons the index agrees with the standard more closely than does a doctor; twice it agrees as closely, and twice less closely.

TABLE XXI

Comparing Index and Doctors in Screening Boys Assessed Subnormal

Standard	Number of Boys, Subnormal according to Standard, also Subnormal according to:				
	Dr. 1	Dr. 2	Dr. 3	Dr. 4	Index
Dr. 1	*26*	17	14	19	18
Dr. 2	17	*29*	14	20	17
Dr. 3	14	14	*24*	15	17
Dr. 4	19	20	15	*38*	20
Index	18	17	17	20	*43*

Fifty-two boys are placed in the subnormal grades by doctors 2, 3, or 4. Doctor 1 finds 23 of them subnormal and the index screens 28. Fifty-one boys are placed in the subnormal grades by doctors 1, 3, or 4. Doctor 2 finds 25 of them subnormal and the index screens 29. Forty-nine boys are placed in the subnormal grades by doctors 1, 2, or 4. Doctor 3 finds 19 of them subnormal and the index screens 25. Forty-five boys are placed in the subnormal grades by doctors 1, 2, or 3. Doctor 4 finds 28 of them subnormal and the index screens 26.

If we adopt as our criterion not the unconfirmed opinion of any one doctor, but the agreed judgment of two or more, we find:

TABLE XXII

Agreement between Doctors and Index

Doctors	Number of Boys in Grades C or D according to at least 2 of the 3 Doctors	Number of Boys in Column 2 Assessed Subnormal by Remaining Doctor	Number of Boys in Column 2 with Index 970 or Lower
2, 3, and 4	29	19	18
1, 3, and 4	24	18	18
1, 2, and 4	30	16	21
1, 2, and 3	23	18	17

On the whole it appears that if we want to pick out the boys said to be subnormally nourished by any one doctor, or by the joint opinion of any two, the index may be relied upon to do this at least as well as a randomly chosen doctor. It is true that the index picks out a larger total number of boys,* but, it may be said, this is the price which must be paid for employing a device which can be used by anyone capable of measuring height and weight accurately, in preference to a highly trained medical man.

These findings concerning the reliability of the method of clinical assessment were important and disturbing. There remained, however, a possibility that the results were accidental in the sense that the particular sample of doctors chosen for comparison might not fairly represent School Medical Officers in general. In order to explore this possibility it was decided to hold further enquiries on similar lines.

The Chief School Medical Officer of Manchester was good enough to arrange for four of his Assistants, two women and two men, to examine 168 boys—the entire population of the Senior Boys' Department of a Manchester school. The procedure was similar to that adopted in the Liverpool enquiry except that it was agreed to adhere to the A B C D classification of nutrition, recommended by the Board of Education. During the examination, however, one doctor felt unable to place certain boys in any of these grades and wrote them down as A–B, or B–C. The results of the Manchester enquiry were similar to those obtained in Liverpool. The four doctors agreed unanimously on 43 per cent. of the boys examined. Over the question of whether a boy is satisfactorily nourished or not they agreed in 115 cases, and disagreed in 53—that is, 31·5 per cent. The doctors agreed unanimously on only 1 out of a total of 28 boys in Grade C.

Through the kind co-operation of the Medical Officers of Health of the Lancashire and Cheshire County Councils and of the Bootle and Wallasey County Borough Councils, a similar enquiry was conducted in a school at Prescot. Four male School Medical Officers took part, one from the staff of each of the four local authorities mentioned, and the Board of Education's classification was used throughout. These four doctors, though they came from different areas, nevertheless agreed rather better than did the four colleagues at Liverpool or at Manchester. Their opinions were unanimous concerning 60 per cent. of the 155 boys examined. They agreed as to whether a boy was satisfactorily nourished or not in 74 per cent., and disagreed in 26 per cent. of the cases.

Turning to the agreement between Tuxford's index and the doctors at Prescot, we find that there are 51 boys—that is 33 per cent.—with an index of 970 or lower. These include 38 out of the 49 boys placed in Grade C or D by one doctor or another. Table XXIII shows that, whichever doctor we take as "Standard," the index picks out more of the boys said by him to be subnormal than does any other doctor.

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* On the average the doctors find 20 per cent. of the boys subnormal, while the index picks out 30 per cent.

Table XXIII

Comparing Index and Doctors in Screening Boys Assessed Subnormal

Standard	Number of Boys, Subnormal according to Standard, also Subnormal according to :				
	Dr. 1	Dr. 2	Dr. 3	Dr. 4	Index
Dr. 1	*19*	14	15	13	17
Dr. 2	14	*37*	28	26	32
Dr. 3	15	28	*33*	24	30
Dr. 4	13	26	24	*35*	30
Index	17	32	30	30	*51*

Table XXIV shows how far one doctor selects as ill-nourished the boys who are so described by at least two of his colleagues, and the performance of Tuxford's index is compared with the agreement among medical men.

Table XXIV

Agreement between Doctors and Index

Doctors	Number of Boys Subnormal according to at least 2 of the 3 Doctors	Number of Boys in Column 2 Assessed Subnormal by Remaining Doctor	Number of Boys in Column 2 with Index 970 or Lower
2, 3, and 4	34	14	32
1, 3, and 4	32	26	30
1, 2, and 4	33	26	31
1, 2, and 3	33	24	31

These results are even more favourable to the index than those obtained in Liverpool and justify the claim that, when used as suggested, the index will agree with any one doctor, and with the joint opinion of any two doctors, in their selection of ill-nourished children, at least as well as another doctor.

Through the kindness of the School Medical Officer of the Breconshire County Council we were provided with the material of a somewhat similar enquiry he conducted with six School Medical Officers, three women and three men, representing three local authorities. These six doctors agreed unanimously on only 19 of the 100 children examined, and 17 were placed by them in 3 different grades. There was a difference of opinion of 1 grade in 64 cases, and of 2 grades in

17. The doctors agreed as to whether a boy was satisfactorily nourished or not in 48 cases, and disagreed in 52.

The Consistency of Individual Doctors' Assessments of Nutrition

It is of course possible for doctors to differ in their opinion of children's nutrition, and yet for each doctor to be consistent in his judgments. His standards, though different from those of his colleagues, may be constant, and uniformly applied. The next step in the procedure was therefore to enquire into the consistency of individual doctors in their assessments of the nutrition of the same children.

The Medical Officer of Health of the Cheshire County Council was good enough to provide facilities for such an enquiry. The School Medical Staff of the Cheshire County Council, three women and two men doctors, took part in the enquiry, which was held at Northwich on two dates seven days apart. This interval must be regretted, but the exigencies of the School Medical Service made it difficult to spare the doctors from their ordinary duties twice in the same week. It is impossible to estimate the extent to which the nutrition of the children may have altered within seven days, but in the opinion of the doctors themselves, and of independent experts consulted, no perceptible difference would be likely to occur in a child's state of nutrition in a week, apart from such exceptional disturbances as starvation or grave illness.

About 100 children were examined in each of two schools, one good and one poor, the doctors taking as much time as they desired over each child. The resulting distributions are shown in Table XXV. In this table three features call for comment. The first is the extraordinary differences which occur between the distributions of nutrition reported by these experienced colleagues. To illustrate, on the second occasion, doctor 1 found only 3 subnormal boys, while doctor 4 found 90. The second point is the difference between the distributions of nutrition according to the same doctor on the two occasions. For example, doctor 2, on the second occasion, increased the number of "excellents," and decreased the number of "subnormals," by about half. Thirdly, it will be observed that on the second occasion every doctor found more boys excellently nourished, and, with the exception of doctor 4, fewer subnormally nourished. A possible explanation is that, on the first occasion, the good school was visited first, and the boys in the poor school may, by contrast, have appeared unduly poor; whereas on the second occasion the order of visiting the schools was reversed, and therefore the boys in the good school may have appeared particularly good. This explanation, if valid, points to the strong influence of recent clinical experience on the doctors' judgments of nutrition.

Table XXV

Distributions of Nutrition according to School Medical Officers in the Same Population on 23.2.37 *and* 2.3.37

Nutrition	Doctor 1		Doctor 2		Doctor 3		Doctor 4		Doctor 5	
	Examn.		Examn.		Examn.		Examn.		Examn.	
	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.
A	36	48	16	23	8	14	20	32	12	18
B	146	142	137	147	133	147	83	71	124	129
C	11	3	40	23	52	32	76	77	57	45
D	—	—	—	—	—	—	14	13	—	1
Totals ...	193	193	193	193	193	193	193	193	193	193

Tables XXVI and XXVII strengthen the evidence set forth in the previous pages. Table XXVII, for example, shows that these five colleagues agreed unanimously on less than a quarter of the cases, and that in 10 per cent. a difference of two grades occurred. The similarity of the discrepancies between the doctors in the two examinations is important, for it suggests that the magnitude of the differences is not accidental but significant and stable. On both occasions in more than half the cases, the doctors failed to agree over the crucial question of whether a boy is satisfactorily nourished or not.

Table XXVI

Agreement among Doctors within each Grade of Nutrition

Grade of Nutrition	Number of Boys Placed in Given Grade by :				
	All 5 Drs.	4 Drs. only	3 Drs. only	2 Drs. only	1 Dr. only
			23.2.37		
A	4	1	3	14	31
B	39	58	39	28	23
C	—	17	27	24	39
D	—	—	—	—	14
Totals ...	43	76	69	66	107
			2.3.37		
A	5	5	13	10	31
B	36	67	36	32	16
C	—	6	21	21	51
D	—	—	—	1	12
Totals ...	41	78	70	64	110

TABLE XXVII

Degree of Difference among Doctors

Maximum Difference	23.2.37		2.3.37	
	No. of Boys	%	No. of Boys	%
None	43	22·3	41	21·3
1 Grade	131	68·0	133	69·0
2 Grades	19	9·7	19	9·7
Totals	193	100	193	100

Table XXVIII shows in detail the changes in the doctors' assessments. The rows give the number of boys placed in each grade of nutrition in the first examination, and the columns show the grades in which those boys were placed a week later. One of the five doctors changed his assessment in 20 per cent., and the other four in from 27 to 31 per cent., of the 193 cases. This means that, on the average, they placed one boy out of four in a different grade in the second examination. The table shows that one doctor changed a C into an A, and another changed an A into a C. It will be seen that, just as doctors agree with one another most closely concerning Grade B boys, so it is in this grade that they agree most closely with themselves. The table shows also that though the general tendency on the second occasion was to raise the number of boys in Grades A and B, yet the movement was by no means a one-way traffic.

For practical purposes, however, we may ignore changes in assessments from A to B, and vice versa, and from C to D, and vice versa. But it is important to know how far doctors are consistent in assessing boys subnormal. Column 2 of Table XXIX shows the number of different boys assessed subnormal on one occasion or the other, and column 3 shows the number and percentage of those boys who were assessed subnormal on both occasions. Column 4 is the obverse of column 3, and shows the number and percentage of boys assessed subnormal on one occasion, and normal on the other. The consistency of the doctors' judgments varies from 8 per cent. with doctor 1 to 70 per cent. with doctor 4; the median is 29 per cent.

The Medical Officer of Health for Bolton kindly allowed us to repeat the experiment in his area with two local School Medical Officers and three others, for whose services we are indebted to the Medical Officers of Health of Leigh, Southport and Wigan. Three of the doctors were women and two men. The procedure and conditions at Bolton were similar to those at Northwich, except that the difference between the boys in the poor and good schools was, apparently, not so great.

TABLE XXVIII

Changes within each Grade of Nutrition between 23.2.37 *and* 2.3.37 *according to Doctors' Assessments*

		2.3.37																								
		Dr. 1					Dr. 2					Dr. 3					Dr. 4					Dr. 5				
		A.	B.	C.	D.	Totals	A.	B.	C.	D.	Totals	A.	B.	C.	D.	Totals	A.	B.	C.	D.	Totals	A.	B	C.	D.	Totals
23.2.37.	A	19	17	—	—	36	11	5	—	—	16	6	2	—	—	8	16	3	1	—	20	11	1	—	—	12
	B	28	116	2	—	146	12	116	9	—	137	8	112	13	—	133	16	52	15	—	83	7	108	9	—	124
	C	1	9	1	—	11	—	26	14	—	40	—	33	19	—	52	—	16	56	4	76	—	20	36	1	57
	D	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	9	14	—	—	—	—	—
	Totals	48	142	3	—	193	23	147	23	—	193	14	147	32	—	193	32	71	77	13	193	18	129	45	1	193

TABLE XXIX

Consistency of Doctors concerning Boys Assessed Subnormal

Doctor	No. of Different Boys Assessed Subnormal in Either Examn.	Boys in Col. 2 Assessed Subnormal in *Both* Examinations		Boys in Col. 2 Assessed Subnormal in *One* Examn. only	
		No.	%	No.	%
1	13	1	8	12	92
2	49	14	29	35	71
3	65	19	29	46	71
4	106	74	70	32	30
5	66	37	56	29	44

At Bolton, as at Prescot, Medical Officers drawn from different areas agreed more closely than colleagues on the same staff. One contributory reason for this is that they placed a high proportion of boys in Grade B compared, for example, with Northwich; and experience has shown that doctors agree most closely concerning boys assessed 'normal.' The doctors were unanimous in 57 per cent. of the 200 cases on the first occasion, and in 60·5 per cent. on the second. They agreed as to whether a boy was satisfactorily nourished or not in 71 per cent. on the first occasion and in 74·5 per cent. on the second.

The high proportion of boys in Grade B will also to some extent account for the larger percentage of cases—the median is 85 per cent. —in which the doctors agreed with their previous judgments. Nevertheless, three of these doctors were consistent concerning only a half of the boys they assessed subnormal on one occasion or the other. The other two were consistent concerning 69·5 per cent. and 76 per cent. of those cases. The details of the changes are given in Table XXX, where it will be seen that one doctor changed the assessment of a boy by two grades from D to B.

Tuxford's index was calculated for the Bolton boys for the first occasion, and Tables XXXI and XXXII support the claim that, as a device for picking out boys assessed subnormal, the index may be regarded as at least as satisfactory as a randomly chosen School Medical Officer.

Conclusions

The Ministry of Health's Advisory Committee on Nutrition in their First Report * stress the importance of establishing some reliable method of assessing the state of nutrition. They say they are unable to recommend any known method as reliable, but that, so far as their present knowledge goes, the clinical method recommended by the Board of Education is the most promising. They

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* Page 26 (1937).

TABLE XXX

Changes within each Grade of Nutrition between 20.4.37 *and* 27.4.37 *according to Doctors' Assessments*

		27 4 37																								
		Dr. 1					Dr. 2					Dr 3					Dr. 4					Dr. 5				
		A.	B.	C.	D.	Totals	A.	B.	C.	D.	Totals	A.	B	C	D.	Totals	A	B.	C.	D.	Totals	A	B.	C.	D	Totals
20 4.37.	A	—	—	—	—	—	7	2	—	—	9	—	3	—	—	3	13	9	—	—	22	3	3	—	—	6
	B	—	175	4	—	179	9	160	5	—	174	2	148	6	—	156	5	137	7	—	149	1	148	9	—	158
	C	—	2	19	—	21	—	6	10	1	17	—	19	15	—	34	—	4	10	6	20	—	14	20	1	35
	D	—	—	—	—	—	—	—	—	—	—	—	1	3	3	7	—	—	2	7	9	—	—	1	—	1
	Totals	—	177	23	—	200	16	168	15	1	200	2	171	24	3	200	18	150	19	13	200	4	165	30	1	200

TABLE XXXI

Comparing Index and Doctors in Screening Boys Assessed Subnormal

Standard	Number of Boys, Subnormal according to Standard, also Subnormal according to:					
	Dr. 1	Dr. 2	Dr. 3	Dr. 4	Dr. 5	Index
Dr. 1	*21*	7	13	10	10	10
Dr. 2	7	*17*	12	15	15	12
Dr. 3	13	12	*41*	21	20	22
Dr. 4	10	15	21	*29*	23	20
Dr. 5	10	15	20	23	*36*	21
Index	10	12	22	20	21	*45*

TABLE XXXII

Agreement between Doctors and Index

Doctors	Number of Boys Subnormal according to at least 2 of the 4 Doctors	Number of Boys in Column 2 Assessed Subnormal by Remaining Doctor	Number of Boys in Column 2 with Index below 970
2, 3, 4, and 5	33	11	22
1, 3, 4, and 5	37	16	22
1, 2, 4, and 5	30	21	20
1, 2, 3, and 5	34	24	21
1, 2, 3, and 4	32	23	20

expressly record the view that research into this problem should continue.

In so far as they bear on the problem of the assessment of nutrition, the results of the present enquiry may be summarized under three heads:

(1) The experiments at Liverpool, Prescot and Bolton suggest that Tuxford's index may prove a useful and convenient device for the comparison of the nutrition of different *groups* of children. But further research into this question is necessary.

(2) Tuxford's index, used in the way suggested, may be relied upon, at least as confidently as a randomly chosen School Medical Officer, to pick out boys assessed subnormal by another doctor, or by the joint opinion of two doctors. On the average, the experienced School Medical Officer picks out two-thirds, and the index three-quarters, of the boys assessed subnormal by two or more doctors. For this purpose, no doctor is greatly superior to the index, but the index is twice as effective as some doctors. It must be added that, in the populations sampled, the average School Medical Officer picks out 18 per cent. and the index

28 per cent. of the boys examined. Nine out of ten School Medical Officers who were questioned on the subject said that in this enquiry they did not place boys in Grade C or D unless satisfied that they were, beyond question, subnormal. No method of measuring nutrition can be regarded as satisfactory which passes as normal even a quarter of the boys who, in the opinion of at least two experienced physicians, are definitely subnormal.

(3) Perhaps the most important part of the work reported in this paper is that concerned with the reliability of clinical assessments. It has been shown that the distribution of nutrition found in a given population and the number and identity of the boys assessed subnormal are largely dependent upon the particular doctor who makes the assessments. The doctors compared in this enquiry were, with one exception, persons of long experience, and all were urged to take as much time as they wanted over the assessment of each boy. Nevertheless, these doctors show important disagreements not only with each other, but also with their own assessments of the same population after a short time interval. The present criticism is directed against the method, not against the doctors concerned; in fact the care these doctors would take, knowing the purpose of the enquiry, leads one to fear that the results set out in the previous pages may show the position in an unduly favourable light.

Particular attention must be drawn to the fact that, if the figures are taken at their face value, wide discrepancies are masked by an apparent similarity in the distributions of nutrition reported by some doctors. This superficial similarity has misled the Board of Education into believing that the method of clinical assessment recommended in Administrative Memorandum 124 gives " some concept of the state of nutrition of school children in the country as a whole " * and that the return of similar figures for similar areas is proof of a " common standard " of nutrition. As a result of this enquiry, one may venture to claim that the method of assessing nutrition at present followed by School Medical Officers, on the direction of the Board of Education, is unreliable. The results obtained by that method are, to say the least, of doubtful value. The conclusions to which they point are insecurely founded; they may give the impression of effective action without the reality.

A fundamental question still remains : Is " the state of nutrition " an entity capable of valid measurement? The urgency and high importance of this problem should need no emphasis.

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* *Health of the School Child*, 1935, p. 19.

My thanks are due to all those whose co-operation has made the present enquiry possible, and particularly to Drs. Gamlin, Kingsford and Howard, School Medical Officers, and Messrs. Ashcroft and Hoole, Head Teachers with the Liverpool Education Authority. No formal acknowledgement can adequately express my indebtedness to Mr. D. Caradog Jones, who suggested the subject of this enquiry to me and who has directed the work throughout.

DISCUSSION ON MR. R. H. JONES'S PAPER.

DR. BRADFORD HILL: The Society is, I think, fortunate in having presented to it this admirably clear and interesting paper at so opportune a moment. Whilst the arena resounds with the cries of those engaged in the search for physical fitness and echoes with the counter-cries of those who regard the national diet with doubt if not with despair, there is an obvious advantage in standing quite still and taking stock of the ways and means by which we hope not only to detect individuals with whom all is not well, but also to assess the effects upon them of changes in their dietetic habits or physical activities. None of us, I feel sure, has the slightest doubt that a certain amount of exercise together with good food and a mixed diet are very desirable things to secure (that is, of course, for other people —for ourselves, I expect, we shall continue to take a bus and eat the grossly unbalanced diet that pleases us). The difficulty is to assess what it is the other man needs and what effect it will have upon him if we fulfil his needs. Mr. Jones has studied the problem from the point of view of the nutritional state of the child, the most important aspect in the eyes of the nutritional experts, who tell us that correct feeding is of paramount importance for the growing organism and that the effects of dietary deficiencies at this stage of existence may persist throughout life. But how we shall determine which children are not having their essential needs met he has shown us to be, with existing methods, an extremely difficult task. I believe that most of us before listening to his paper would have felt that clinical judgments might very well differ with border-line cases, whether a child was normal or slightly sub-normal, but that on the extremes, excellent and bad, there would be relatively little difference in medical opinion. That belief Mr. Jones has shown us to be an illusion. The same children are not similarly placed by the clinical assessors even in the extreme groups. This position leads naturally to the search for purely objective tests, based upon physical or physiological measurements. The assessment of the value of such tests seems to me to involve two difficulties. The first arises out of the relation that Mr. Jones shows between physical measurements and nutritional status. Boys said by the school medical officer to be well nourished are on the average heavier and larger in their skeletal measurements than those described as of unsatisfactory nutrition. Mr. Jones concludes that,

> "the fact that the physician's judgment of the state of nutrition is associated in this way with these objective physical measurements justifies the hope that they may prove useful, for the purpose of picking out for more detailed examination, the kind of children a doctor would describe as ill-nourished." (p. 12.)

But may we not here be arguing in a circle? Can the doctor exclude from the factors influencing his judgment these physical measurements themselves? The clinical signs noted included, we are told, general appearance, amount of muscle and muscular tone, amount of subcutaneous fat. An effort was made by the doctors concerned to take no account of heights or weight, but I am rather doubtful whether such efforts can be really effective. The fact that nutritional grades are best distinguished by weight, then by chest, and finally by height *may* be evidence of the order of merit of those objective tests, but it may merely denote that weight is the factor most difficult to exclude from the clinical assessment. If weight does enter into the clinical assessment, then we are bound to get an agreement between the objective and subjective tests. The objective test must tend to pick out the same boys as the subjective test if the latter, unconsciously perhaps, includes the former.

The second difficulty arises out of the fact that, as Mr. Jones clearly points out, we have to measure the value of our different objective indices by correlating their performance with the medical officer's assessments. In other words, we want to find a substitute for a means of assessment which on Mr. Jones's own showing is seriously defective; and as a test of the value of that substitute we compare the results it gives with the results of a test that we know to be poor if not useless.

Our index may in fact be a very good one. We have no real means of knowing, for we have no true discrimination of satisfactory nutrition and malnutrition against which to check it. That seems to me to be a logical difficulty from which at present there is no means of escape. If for physical measurements we substitute physiological tests such as are being used at present—the strength of pull, tests of co-ordination, etc.—we are still in exactly the same position. We want to know whether those tests will pick out boys suffering from malnutrition, and again the only other means we have of defining those boys is the clinical assessment that we want to supplant because of its known defects. If the test fails to pick out certain boys clinically assessed as bad, or picks out certain others clinically assessed as good, is it because the test is bad or the clinical assessment is bad? In the absence of Mr. Jones's analysis I should have been inclined to fall back on the belief I previously mentioned—that at least boys defined as excellent really differ from boys defined as bad, and that one medical officer will, at any rate, be consistent in his judgments. Mr. Jones shows us that neither of those tenets is necessarily true. A few boys are placed by different medical officers several grades apart, and the medical officer, according to Mr. Jones's experiment, places one boy in four in a different grade at a second examination made within a week of the first.

The only way of escape that I can see lies in the development of objective tests of dietary deficiencies which can be proved to be related to such deficiencies without the introduction of clinical assessments at all. The kind of test I have in mind is this. (I quote from a recent paper in the *Lancet.*) It is accepted that night-blindness is associated with vitamin-A deficiency and that it can be cured by the administration of a potent source of this vitamin. It seems that the visual purple of the eye, the pigment which is bleached by light in the process of vision and reconstructed in the dark, is a compound substance of which vitamin A is a constituent. These observations have led to attempts to measure the capacity of the eye to adapt itself to changing conditions of light and darkness under standardized conditions. Briefly, the test is to make the person distinguish between varying graded degrees of illumination either as dark letters or bright spots against a ground with which they are in graded degrees of contrast. By a number of trial tests on healthy individuals on good diets a standard is set up and varying groups of children are assessed against this standard. In the experiments to which I am referring it was found in this way that of a small group of public-school boys 90 per cent. were normal, 10 per cent. slightly sub-normal, none definitely sub-normal; of groups of elementary-school children only 40–45 per cent. were normal, a quarter to a third were slightly below normal, a quarter to a third definitely sub-normal. Treatment of the sub-normals with vitamin A showed at a later re-examination that a very large proportion of the children either became normal or showed appreciable improvement, a change not exhibited by untreated children. It seems to me that it is in a direction such as this that salvation must eventually lie, that here we may have evidence of a specific dietary deficiency with which to correlate our physical or physiological indices. (I say " may " because in fact the method has been criticized fairly severely in America.) Admittedly at the best it measures only one particular deficiency. Mr. Jones naturally would like to find an index which would define malnutrition in general. So would we all. He has clearly shown us the dangers of accepting the clinical assessment for that purpose; he has done all that is possible at present to enable us to value the spate of indices which have been proposed as substitutes for it. For that very careful and useful work I have much pleasure in moving a vote of thanks to him.

DR. UNDERWOOD : I have much pleasure in rising to support the vote of thanks which has been so ably proposed by Dr. Bradford Hill. Mr. Jones has dealt with a problem which has been wooed by the scientist, anathematized by the administrator, and exalted by certain sections of the lay public. He is to be congratulated on the thoroughness of his investigation, and on his courage in demonstrating how difficult it is to obtain satisfactory information on the lines which have been laid down in official circles.

Apart altogether from the extremely valuable comparison of the performance of different indices of nutrition, I would suggest that possibly the most striking result of the investigation is the demonstration of the apparent futility of the clinician's judgment, so far as the assessment of nutrition is concerned. I suppose that most persons who have had experience of this work will admit that a doctor's opinion is coloured by his environment; but few of us would have realized that our conception of the state of malnutrition could change radically in the short space of seven days!

In dealing with the question of the clinical assessment of nutrition, I should like to suggest that the grouping adopted in this investigation is an extremely fine one, and that therefore a certain amount of overlapping between different subjects is inevitable. This possibly does not create much difficulty so far as the general results of the survey are concerned. But when we come to consider the assessment made in respect of individual cases by different doctors or by the same doctors at different times, the results are possibly more liable to be misconstrued. For example, in Table XVII the agreement among doctors in respect of boys who have been assessed as sub-normal is derived from the data from which Table XIV was constructed; and the correlations between doctors are calculated from the same data. In other words, these particular results were based on assessments of nutrition according to no less than eight different categories. I have no fault to find with the statistical principle involved in the ultimate division of the boys into two broad categories. By this additive process it is shown that one doctor found nearly three times as many boys with sub-normal nutrition as did one of his colleagues, and that out of the fifty-five boys who were placed in Grade 3 or below according to the opinion of one doctor or another, only eight were there by a unanimous verdict. It seems to me that these results were due in part to the fact that the doctors who carried out the clinical examinations had before them too many courses of action, and that the results are perhaps in part explained by this circumstance. Mr. Jones suggests, of course, on p. 21 that when the groups are reduced to four—as in the classification suggested by the Board of Education—and finally to two, there is less room for disagreement. But my point is that this reduction to fewer groups was obtained from the assessments which were originally made in eight different categories. When a doctor has so many possibilities in his mind we can hardly blame him if he sometimes pursues an illusive shadow and allows the substance to escape him. I suggest that chance plays a very important part in determining whether a doctor places a child in Grade 4— or in Grade 3+, yet this apparently minor point would have an important bearing on the issue. For such a purpose the clinician should be given only two alternatives—namely, whether an individual boy's state of nutrition is satisfactory or unsatisfactory. It is obvious that in the Manchester enquiry one of the doctors felt that he was unable to adopt any finer classification than this, and I find myself wondering whether, if they had all adopted the same principle, the correlation between them would not have been materially increased. At the same time, I must admit that there is no apparent explanation of the fact that in certain cases at the extremes of the scale the opinions of different doctors were mutually inconsistent.

Mr. Jones evidently recognizes the difficulty of these border-line cases, some of which he designates by the name of "freaks." On p. 15 he tells us that in order to allow for the existence of these individuals it was decided to aim at securing, by the aid of the particular index tested, 80 per cent. instead of 100 per cent. of the boys in Grade 3. It seems probable that those boys who are not picked out by the index may be responsible for the fact that, in general, it gives a so-called "better" result than any one doctor.

I should like to say that I think the paper brings out very clearly the difficulties associated with the clinical assessment of nutrition. If the administrator decides to base his policy on the results of examinations by individual doctors, it would appear that in order to justify his action he must have, in certain cases at least, repeat examinations. Since such a procedure would be fraught with much expense, can we blame him if he asks "*Quis custodiet ipsos custodes*"? Dr. Hill has mentioned a recent paper in which I am interested. This retinal test is apparently more speedy and more satisfactory than some of the other tests for nutrition which have been proposed, but it cannot be used as a routine measure applied to large numbers of children. Until a foolproof test which is simple in application is devised, the best method of picking out under-nourished children would appear to be to use Tuxford's index, and to consider as "freaks," to be dealt with at a later date, those children who pass through its meshes. I think you will agree that it could reasonably be argued, taking into account the fact that the experience of a school medical officer is apparently somewhat fallacious, that the results would not unduly distort the returns made to the Board of Education.

It gives me very great pleasure to support this vote of thanks to Mr. Jones for his extremely interesting paper.

DR. MAGEE considered the paper to be extremely valuable and interesting: it was undoubtedly a conscientious attempt to throw light upon a very difficult and thorny subject. Dr. Magee did not think that the question whether the state of nutrition was an entity capable of valid measurement could be answered "Yes" or "No" at the present time; our knowledge was not nearly sufficient. It was obvious, especially after hearing the remarks of Dr. Bradford Hill, that in this matter they were dealing with a state of affairs which was, as it were, shaking like a quagmire, with nothing fixed or certain in it. The assessments of the doctors, as was shown in the paper, were in many cases related to the stature of the child. Was stature a definite index of nutrition? Before that question could be answered another question must be asked—what stature signified so far as nutrition was concerned? The stature of an individual represented the balance of the metabolic processes between the time of birth, or maybe of conception, and the time in question. It was not a measure of the state of health or of the physiological condition of the individual at the time, which was the knowledge the school medical officer more particularly wanted to have—the state of nutrition of the child here and now.

One frequently observed children who, as far as one could judge clinically, were in a good state of nutrition at the time, but who bore the stigmata of rickets, for example, bandy legs and so on, thus showing that stature could not be relied upon. It was most unfortunate that in this matter protagonists spoke for different methods, some for anthropometric, some for clinical and some for physiological methods.

He would like to draw attention to the procedure of the physician when he came to examine a patient. There was no clash between objective tests and clinical methods. The physician took the history of the patient, then had a good look at him, took his temperature and pulse rate and made various objective tests. Finally, after weighing up all the evidence, he came to a conclusion. This question, if it was to be settled at all, would not be settled by putting the anthropometric methods against the clinical and physiological methods, but by combining the three. If that were done the examination might be a very complex matter. This brought him to the question put forward by Mr. Jones in his paper as to whether it would be possible to get a " screen " which would pick out the badly nourished. A few simple objective tests would be necessary, but it must be remembered that the clinical method was indispensable. This was a physician's job, and whatever objective tests were devised they would have to be weighed along with the clinician's impressions. If such tests could be obtained, then the children who were screened would be submitted to more detailed tests, such as the Vitamin-A-deficiency test, and perhaps others, which it was hoped future research would bring forward.

DR. GLOVER felt that, as he had the honour to be a Medical Officer of the Board of Education, he was perhaps the villain of the piece. Nevertheless he would like to begin by congratulating Mr. Jones on his careful and lucid paper, so full of criticism and yet so gentle in its handling of the many discrepancies he had found in the clinical method.

Dr. Glover said it was his duty to study year by year the tabulated returns of all the 316 Local Education Authorities, and without doubt there was considerable difference in the interpretation of the terms "Excellent," "Normal," "Slightly Sub-normal" and "Bad," used in the simple classification. Mr. Jones had properly shown the differences in standards of the medical officers; his paper showed him to be one of those

> " . . . who with due steps aspire
> To lay their just hands on that golden key
> That opes the portals of . . .

" consistency " let us say; he was a slave to consistency. Dr. Glover rather feared, however, that this admirable paper might have given some of his hearers impressions which were not wholly correct. The first was that by taking the Tuxford index Mr. Jones had really got his hand on that golden key to the assessment of nutrition in children. Personally, he had the gravest doubt as to whether such an index, derived from two anatomical physical measurements taken on one occasion, could be much of a guide to what was really a physiological concept—nutrition.

He agreed that if the Tuxford index were very low in the case of a child, that child was almost certainly mal-nourished, so mal-nourished in fact that no formula or expert examination was needed to select him. The Report * (1937) of the Group of Experts of the League of Nations said, " Measurements of height and weight may serve for the easy detection of some of these somewhat exceptional cases of pronounced malnutrition, but cannot give any indication as to whether this condition is due to organic or to dietary causes."

The continuous observation over months of such measurements was, on the other hand, evidence of great value.

There was one reason why the operation of a mathematical index such as Mr. Jones had chosen might appear superior to clinical assessment. The results given by his index had a definite boundary; he had decided that this boundary was fixed at 970; below this the nutrition was unsatisfactory, and above, satisfactory. When the doctors classified the children clinically as excellent, normal, slightly sub-normal and bad, there was obviously no fixed boundary possible between such classes. A number of people would always be found on the borderline, and it would be difficult to divide the excellently from the normally nourished and even more difficult to divide the normal from the slightly sub-normal. If the four classes suggested by the Board were reduced to two, it might look very simple to determine " satisfactory " from " not satisfactory," but there would still be many persons on the borderland between " normal " and " slightly sub-normal." It did not follow that these doctors were differing so greatly, because there were enough people on the borderline who could legitimately be classified in either grade. The child seen a week ago and considered normal then, who had since had three bad nights with toothache, might on the second examination legitimately be placed below sub-normal.

The Board had adopted this method after careful investigation made by an experienced physician and in accordance with practically all the best medical opinion. Dr. Robert Hutchison had always held that malnutrition was essentially a clinical concept to be gauged not merely by weight, but by state of the skin, lustre of the hair and so on.

There was one other point. Mr. Jones was very fair, but on p. 2 he said " guided chiefly by facial appearance, but also by posture and general demeanour." On pp. 6 ff. he discussed the figures derived from routine examination.

In this connection it would be interesting to read exactly how the examination was supposed to be made. These directions

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* Bulletin of the Health Organisation of the League of Nations, Vol. VI, Extract No. 5, p. 142.

did not rule out but included consideration of height and weight. They run thus :—

> "The main issue is to estimate the general well-being of the child. Such general assessment cannot as a rule be based upon any single criterion such as any ratio of age, sex, height and weight. It should also have regard to other data derived from clinical observance, for example, the general appearance, facies, carriage, posture; the condition of the mucous membranes; the poise and functioning of the muscular system; and the amount of subcutaneous fat. The alert, cheerful child, with bright eyes and a good colour may usually be accepted without demur as well-nourished. On the other hand the child who appears dull, listless and tired, who has a muddy complexion or stands slackly, is at once under suspicion and should be further examined. Too much reliance on a single sign may lead to error. Carious teeth and other local defects should not in themselves be regarded as evidence of faulty nutrition. It is the general impression which decides the issue."

Some of the great differences in the A (excellent) class were undoubtedly due to disregard of these directions. Some doctors would not class any child as A unless he had perfect dentition.

Dr. Glover said he would like to point out that in Circular No. 1443 the Board had urged that the provision of free meals or of milk or of both might properly be made, for any child, whose parents were unable to pay, who showed any symptoms, however slight, whether educational or physical, and that recommendations for such feeding should not be confined to the Medical Officers, but might properly be received by the Local Education Authority from teachers, school nurses, school attendance officers, and others in regular contact with the children from day to day. If, for example, a teacher, who was able to observe a child all through the week, found him to be dull and listless, and considered these educational symptoms to be due to lack of food, the Authority had the power to feed that child and the Board would pay half the cost. Such observations by those in closest touch with the children could go far towards filling any gaps left by clinical assessment. The proper treatment of sub-normal nutrition in necessitous children demanded three essentials : (1) proper assessment, (2) adequate provision and (3) appropriate income scale of necessitousness. The Board did its best to secure that the Local Educational Authorities responsible should provide these.

Dr. Glover did not want anyone to think that as a result of an admittedly imperfect method of clinical assessment, of which the faults had been so ably and kindly pointed out by Mr. Jones, any child need go hungry through being missed.

MR. C. A. RICHARDSON said he would like to put two points to Mr. Jones. There seemed to be a possible reason why any index of the type used could not by itself, without modification, be a valid index of degree of nutrition. The use of it appeared to make one fundamental assumption—namely, that the value of the index for all perfectly nourished individuals of the same age would be the same. On the face of it that seemed to be a fairly large assumption. All were familiar with the tables on weighing machines, saying that if the height was so and so, and age so and so, the weight should be so and so.

It would seem possible that what might be the normal or optimum value of the index might depend, for example, upon the body type of the individual, and therefore he suggested that as a preliminary to any investigation of this kind an attempt should be made to divide the children into sub-groups, according to some such classification as body type, and then to determine the normal or optimum value of the index for each sub-group. If that were done, the measure of the nutrition of any individual might be the value of the index for that individual as compared with the optimum value of the index for his particular sub-group.

The other point was this question of the criterion. The phenomenon that Mr. Jones discovered—the unreliability of subjective judgment—cropped up in all kinds of connections. For example, even the most competent and learned examiners would differ extraordinarily in the way they marked the same essay paper. He suggested that a criterion might be obtained in this way—not by taking the judgment of one or even two doctors, but the pooled judgment of several, and if that were done it would be possible also to form an estimate of the reliability of this judgment. If that could be found, it was possible that by appropriate statistical procedure the correlations might be corrected for attenuation, and it might then be found that the correlations, as corrected, would in fact be a good deal higher than might otherwise appear.

Dr. Simpson said that Mr. Jones had shown very clearly how difficult it was to get reliable estimates of the nutrition of schoolchildren, and it seemed to him that there might be two fundamental reasons for this. First of all, it might be that they had not yet defined, or perhaps could not define, sufficiently clearly what it was that they wanted to assess. Secondly, he felt that they were perhaps asking for an accuracy which, in the nature of things, was unobtainable. What was the nutritional state of a child? Dr. Simpson supposed that a physiologist could give some accurate definition, but in general there was a good deal of confusion of thought, and that led to confusion in assessment. Mr. Jones had very rightly stressed the need for some simple means of picking out children whose diets needed supplementing, but if nutrition was considered from this point of view alone, and if when a physician was asked to estimate the nutrition of the child he was in effect being asked to say whether the child's diet was adequate or not, difficulties arose at once. In the first place, unless there was evidence of starvation or of some deficiency disease, it was very difficult for him to give a definite answer unless he knew what the diet consisted of. Secondly, amongst schoolchildren dietary faults were almost always linked with others, such as bad housing, lack of fresh air and sunlight, or insufficient sleep, and there was no easy way of apportioning the blame. One could only say that there was something wrong with a child, and later, at leisure, try to find out what it was that was wrong.

For school doctors the practical point was to decide whether a child was well or not, and from that point of view it would be of considerable advantage if the word "nutrition" could be dropped and replaced by some non-committal term which indicated the well-being of the child as a whole. This was a somewhat vague term too and might not be the same thing as nutrition, but at least it should mean something to a clinician, for the first thing a doctor did when he examined a patient was to take stock of his appearance. He was trained to do this, but if he was asked to assess the patient's nutrition, all sorts of ideas were liable to come into his head and vitiate the result. There was, however, the practical difficulty that the well-being of a child was a clinical concept, and so did not lend itself to accurate measurement, and it might be asked whether it was not a mistake to expect results which were of statistical value. At the same time Dr. Simpson would have thought that if an experienced physician were asked to walk round a school and to pick out those children whom he thought needed further examination or investigation, he would be able to do so without missing much of importance, especially if he had the school records to help him.

Dr. Simpson was sceptical about nutritional indices: he did not see how it was possible to express the health of a child in terms of his physical measurements, and even if it were so in a general way, that would not help them to pick out cases of early and slight departure from health, which they were particularly anxious to spot. His own experience of height and weight as an index had not been very satisfactory, if only for the reason that he had found that to screen off all or most of the children who were clinically subnormal, one had to select quite an unduly large proportion of the population being examined, and further he was sure that in ordinary routine school work it was impossible to get measurements with the accuracy that could be obtained in scientific investigations such as had been described that afternoon.

Dr. Daley said he spoke as a medical administrator with a certain degree of responsibility in connection with a large School Medical Service, and he would like to express to Mr. Jones his grateful thanks for the painstaking and valuable enquiry of which he had given the results in his paper.

He had been somewhat perturbed when he read in the later pages the criticisms of clinical assessment, and although he would go on to say later that he thought clinical assessment was a better form of assessment than a mensurational one, he would point out that variability of conclusion based on human opinion was not confined to doctors. For example, he had been comforted to find in an official report on *The Examination of Examinations*, published in 1935, that it was shown that with regard to School Certificate English papers, the same 48 papers being submitted to several examiners, one failed none, and another failed 19. As to the same individual changing his opinion, that also was investigated and the results published in the same report. It was found that of 14 experienced examiners who examined the same papers after an interval of twelve months, in 92 cases out of 210 the same examiner gave a different verdict on the second examination from that on the first. It was clearly very difficult when dealing with matters of opinion to have absolutely consistent judgment either with that of other people or even with that given by oneself some considerable time previously.

With regard to the interest of the school medical service in malnutrition, the main object was to ascertain which individual children were ill-nourished, to investigate the cause and provide the necessary remedy. As a result, additional milk, cod-liver oil or free meals were ordered in many cases at once. It was one of the essential functions of the service to ensure that no child who ought to have this extra nourishment was deprived of it for a single day after the discovery of the need was made. Mr. Jones might suggest that such information as to the individual children concerned could be obtained by weighing and measuring all the children, applying the Tuxford index, and thus deciding which children were ill-nourished. Dr. Daley did not think that would do, and he did not think Mr. Jones would really suggest it, but would say that the index should be used as a screen. Some children, however, whose nutritional state should be investigated would not come through the screen—for example, the over-fat child was unhealthy and just as much in need of dietetic or other advice as the thin child, but the Tuxford index would not pass him through, and he would escape further investigation.

There was one point that had not so far been mentioned in connection with the discussion—a method which had been in operation in London for the last two or three years for the purpose of drawing special attention to children whose nutrition was unsatisfactory. This was a system of six-monthly weighing and measuring of all the children. Dr. Daley thought there was little value, when endeavouring to discover the individual child in need of investigation on nutritional grounds, in looking at a table of average heights and weights for children of that age and sex, but he thought it was important to know whether a child failed to grow normally. Failure to do so was a definite danger signal: also, abnormal gain should be a reason for enquiry.

The classifications which had been referred to that evening were similar to those which were used to give the results of routine inspection, and except, possibly, for statistical purposes to indicate gross changes he did not think they were of great practical value. It was of no particular value to know that at routine inspections so many per cent. were in the various nutritional grades. Comparison was made with previous years and the results deplored or made a matter for congratulation, depending on whether the percentages of sub-normal and bad were higher or lower. The paper by Mr. Jones showed such comparisons as had been made in the past were probably of little value. Nevertheless, it was a very remarkable thing that in London, where large numbers of doctors were assessing nutrition at routine inspections in accordance with the Board of Education's classification, there was remarkable consistency year by year in the mass aggregate. The percentages differed according to the ages and sexes of the children in accordance with physiological expectation, and when different medical officers went to the same district, they were consistent with their predecessors with regard to the mass percentages which they got.

What was wanted, however, was to pick out the individual ill-nourished child. They could not wait for routine inspections to do so. These inspections only take place 3 or 4 times in the child's school life. The people who, in practice, picked out these children and put them forward at any time for extra nourishment were teachers, doctors, nurses and Care Committee workers. The nurse played an important part—if there was failure to gain in height or weight at the six-monthly weighing, the child would be put on special milk or meals, and examined forthwith by the doctor.

In London they were inclined to favour the clinical method as giving a satisfactory indication of the nutritional state of the children. The results, however, were not sufficiently exact or accurate for definite conclusions to be made as to decline or improvement in the general state of nutrition of the child community.

There was another point he would like to make, though it might not be entirely germane to the issue. A great deal was made of increase in stature and weight during recent years, and people assumed that that was a good thing. We would all agree that everyone should have the optimum stature and physical condition which a well-balanced and adequate diet would give him, but he had been endeavouring to ascertain whether or not there were any statistics which would give information as to the relative state of health of the large, tall adult as against the small, wiry one, and could find none. It might be good to raise a race much taller and heavier than the present by giving diets even in excess of those now recommended by the experts, but his impression, from going about the world, was that the big, heavy people were not better lives for Life Assurance purposes or for keeping steadily going at their work throughout their lifetimes than the small, wiry ones. He thought it was time that an investigation was carried out as to the relativity between sickness incidence and mortality and stature and weight of adults.

DR. RHODES said that reference had been made by the last speaker to the work on the comparison of the marks of examiners reading the same scripts. Further, on this subject, one might say that doctors were willing to believe that examiners might err in their assessment of a script, but were unwilling to concede that doctors might err in their assessment of the state of nutrition of a child. One could see resemblances between the endeavours of an examiner to award a mark for an essay either by general impression or by awarding marks for details, such as vocabulary, style, substance, consistency, etc., and those of a doctor assessing the state of nutrition of a child either by general impression or by an integration of evaluations of posture, state of skin, lustre of eyes, etc. Perhaps the differences between assessments of different doctors was due to different emphasis being placed on the various aspects.

Critical references had been made to the difficulties which doctors may have in using so many grades of nutrition as those mentioned in the paper. But, apparently, Mr. Jones was not responsible for the introduction of the additional grades to those suggested by the Board of Education. The doctors themselves found the original four grades inadequate and insisted on subdivisions.

Dr. Rhodes referred to a study * he had made 16 years ago where he was analysing data resulting from School Medical Inspections. There were five doctors concerned in these inspections in one county area, each dealing with different children. For boys of 13, one doctor found 95 per cent. of normal nutrition and 1½ per cent. subnormal, another doctor found 63 per cent. normal and 29½ per cent. sub-normal.

Dr. Rhodes thought Mr. Jones was to be heartily congratulated on his paper and he wished to add his thanks to those of the other Speakers.

The following comments were received after the meeting :—

MR. M. S. BARTLETT : I have no wish to venture any opinion on the relative merit of physical indices and clinical assessments. Possibly, as one speaker suggested, physical measurements can be more easily justified as indices of *changes* in growth and development than as absolute criteria of fitness or state of nutrition. Nevertheless, from Mr. Jones's very interesting and valuable investigation, it appears that a physical index may be at least as good as a single clinical assessment, in sorting out the poorly nourished, and his results appear to me to be as much worth consideration as any *a priori* opinions.

Accepting, then, the view that the performance of a physical index is worth investigating, I should have been inclined to favour some such initial course as follows. The choice of an index might have been based on its correlation with the average results of several medical officers, not one; and these officers need not have been barred from considering qualitatively physical characteristics such as height and weight, if they wanted to, along with other relevant characteristics. Moreover, instead of testing out all the miscellany of arbitrary indices mentioned in the literature, it is a fairly definite statistical problem, of which the theory has been considered by Professor Hotelling in America and Professor Fisher in this country, to ask what function of, say, height, weight and age best discriminates the children. (As a technical point, it would be most convenient to make the statistical analysis in logarithms, but these would be converted back again for the final index.) This might give too complicated a function for practice, but an appropriate simplification of it might always finally be made.

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* *On the Condition of Teeth in School Children,* Drapers' Company Research Memoirs.

Dr. Tugendreich: May I as a guest from Germany offer a short note in respect to the very interesting paper of Mr. R. Huws Jones?

After the war the American Quakers came to Germany to help the under-nourished children. Free meals for children were organised throughout Germany.

At that time I was the director of the Social-Hygienic Department of the Berlin Health Board and a member of the committee—the chairman was Professor Czerny—which had to organize and supervise these meals. The school medical officers had the difficult task of selecting the children. At first only medical examination of the children was made. But the Society of Friends wished to lay down exact figures of measurement. So we looked for an applicable index.

With two other colleagues I was sent to Vienna to examine the "Pirquet index." Professor Pirquet of the University of Vienna has introduced into his index the sitting-height of the child instead of the length of the whole body, because the length of the legs may be affected by some accidental deformity, etc. Apart from this index, Pirquet applied the result of medical examination which was based on the adipose tissue, presence or absence of signs of anæmia and the tone of skin and muscle. In Germany we applied another index—the Rohrer index. Our experience of both the application of the Rohrer index and the medical examination was unsatisfactory. The medical examination gave as unreliable a result as Mr. Jones has pointed out here so clearly. The results of two neighbouring schools, for example, varied from 20 to 80 per cent. of "under-nourished" children. The Rohrer index was also proved to be not useful.

Children of well-to-do families who did not suffer from want in their home were recommended for the free meals because they were thin, according to the Rohrer index. What Mr. Jones has asked at the end of his paper I can answer. The state of nutrition is "not an entity." Quite frequently thinness is constitutional, and has in this case nothing to do with under-nourishment. (We must consider, too, children without appetite who eat too little in spite of their being offered abundant meals.) Professor Pfaundler in Munich therefore suggested dropping the word "under-nourished" and choosing the word "under-filled" (*Unterfülle*) instead. While the word "under-nourished" contains already a hint of the cause of the thinness, the word "under-filled" does not. Children who are constitutionally thin do not succeed in growing fat, at least not for long. If we give thin children much carbohydrate it often at first results in an increase in weight caused by the retention of water in the body. But such a retention is not desirable from the medical point of view.

Real under-nourishment means the state of a person who receives a diet insufficient quantitatively and qualitatively. Real under-nourishment, *i.e.* the fact that the children do not receive sufficient nourishment at home, is best established by means of school nurses visiting the family. The medical examination should naturally establish that disease is not the cause of the thinness, but such a cause is rare.

The main point seems to be that only such children who have not sufficient nourishment at home should be called " under-nourished," and children constitutionally thin but well nourished at home should not be termed " under-nourished." The fact that under-nourishment in the family really exists can be sufficiently established by the home visits of the school nurses.

DR. KANTOROWITSCH : The existing literature on the subject which Mr. Jones has dealt with indicates that it is high time that the problem should be attacked more scientifically than has been done hitherto. Mr. Jones is therefore to be congratulated both on having made an attempt to use experimental methods and on not having come to any definite conclusion. He is to be complimented on the methods chosen; it is to be regretted, however, that he confined himself to boys, since certain investigations suggest that girls are more liable to show the effects of malnourishment than boys. According to Carrol E. Palmer of Washington, the variability of body-weight for boys, measured by the standard deviation, showed no significant difference between periods of depression and prosperity. For girls body-weight was more variable; there were more girls than boys at the ages 6–11 who were 12 per cent. or more below average weight than would be expected had the same proportions been underweight as in the prosperity period.* This confirms the preliminary results of my own investigations on mortality according to age, which are in course of preparation.

Although Mr. Jones has approached the difficult problem more scientifically than most other investigators, I would venture to criticize him on one or two points. It seems to me that he has not made use of *all* the results of his experiments and, particularly, has overlooked a result which is able to bridge the gap between clinicians and anthropometrists. He himself states that, in general, medical officers agree, more or less, on the diagnosis of children of normal grade of nutrition. This can also be easily assessed from the Tables. Table XVII is particularly interesting, inasmuch as it shows that by adding Grade 3+ to Grade " 3 or below," we arrive at a relatively greater proportion of agreement in the assessment " sub-normal " by the doctors than was the case in Grade " 3 or below." In other words, doctors seem to agree better between themselves respecting the state of nutrition when the notion of sub-normal nutrition is widened. We should also bear in mind that the average physician is not, and fortunately cannot be, trained by experience in the assessment of under-nourishment. Mr. Jones undoubtedly took these facts into consideration, but the conclusions he has drawn are perhaps to be regretted as, after all, the rôle played by statisticians is but a modest one; the final judgment belongs to physicians.

* Carrol E. Palmer, *Growth and Economic Depression*, Public Health Report (U.S.A.), Vol. 48, No. 42, pp. 1277–1292.

Another point is that Mr. Jones has not made use of all the methods of statistical analysis which are now at our disposal thanks, in the first place, to R. A. Fisher. Miss M. N. Karn has shown us in two investigations published in 1934–35 in the *Annals of Eugenics* (Vol. 6) that remarkable results can be obtained from anthropometrical data by applying the method of analysis of variance. R. A. Fisher, conjointly with H. Gray, has further demonstrated the importance of this method in the detection of some errors often met with in anthropological measurements.* After all, we have to reckon with the fact that apart from lack in precision in methods of measurement, stature in man is not homogeneous. For instance, an investigation in U.S.A. has shown that the Davenport index $(W)/(H2)$ does not show positive results in dealing with absolutely heterogeneous material.† There is still another point, mentioned also by Miss Karn. E. C. Palmer has put forward an interesting hypothesis that annual increments of weight vary from year to year. He assumes that there are climatologically good growing years and bad ones, and that these circumstances might accordingly strengthen or weaken environmental influences, such as nutrition.‡ For example, the fact that the increment in body-weight was unsatisfactory in the year 1924–25, but the difference was not significant in 1933–34 in spite of the economic depression, led him to say :—

> " It is quite conceivable . . . that the year 1924–25 appears as a poor ' growing year ' because of the influence of several factors which are adverse to growth, while in the year 1933–34 these factors did not operate, but the decrease in growth was brought about by other factors directly attributable to the economic depression." §

Accordingly he was of opinion that one cannot come to any conclusion on the basis of " only " 7 years of observations.‡ Still, Mr. Jones's paper must be considered but a step forward—of course a very important one—on the way to the solution of a most difficult problem.

MR. JONES replied as follows :—

I wish to express my warm thanks for the very kind reception accorded to my paper and for the valuable comments made concerning it.

I should, in the first place, like to reply to certain suggestions and criticisms made in connection with the procedure adopted in the enquiry. Mr. Richardson believes that a more serviceable index might be secured if the normal or optimum value were determined for each "body-type" separately. The concept of body type though valuable for some purposes,* is almost as vague and elusive as the concept of nutrition; moreover, the danger of arguing in a circle, to which Dr. Bradford Hill drew attention, applies here with special force. Who can tell the extent to which the body type of a child may be affected by nutritional factors? Mr. Richardson and Mr. Bartlett suggest that the average opinion of several medical officers might have been accepted as a reliable criterion of nutrition. But one may doubt the assumption that wisdom lies in the *average* opinion of widely divergent counsellors and, since a chief purpose of assessment is to discover children who need extra nourishment, whether it is proper to accept as normal a boy whom two out of five doctors declare to be subnormal. Dr. Kantorowitsch regrets that girls were not included in our enquiry, and both he and Mr. Bartlett remark that use was not made of all available statistical methods. Girls were excluded because they call for separate consideration, especially in connection with chest measurements. Certain recent statistical methods might, as they suggest, appropriately have been used to devise new indices, but as the work proceeded it was felt that there was little merit in adding to the plethora of indices until some reliable criterion is obtained against which indices may be validated. Dr. Daley questions whether there is any positive correlation between physical size and health. Several studies of this problem have been made in America † and Dr. Treadgold of the Royal Air Force ‡ has pointed out that 70 per cent. of all airmen invalided from medical causes were one kilogramme or more below standard weight on entrance.

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* Fisher, R. A., and Gray, H. : " Inheritance in Man : Boas' Data Studied by the Method of Variance," *Annals of Eugenics*, **8** : 74–93.

† Clark, Charles Patton : " A Study of Tables of Average Weights for Heights." *Abstract of the Proceedings of the Forty-sixth Annual Meeting of the Association of Life Insurance Medical Directors of America*, 1936, XXII : 266–287.

‡ Palmer, Carrol E. : " Further Studies on Growth and on Economic Depression," *Public Health Reports*, **49** : 1453–1469.

§ Palmer, Carrol E. : " Variations of Growth in Weight of Elementary School Children, 1921–28," *Public Health Reports*, **48** : 997–1004.

The passage on p. 2 to which Dr. Glover objects—"guided chiefly by facial appearance, but also by posture and general demeanour"—refers specifically to a rapid review intended to select children for further examination and not, as Dr. Glover suggests, to the complete clinical examinations. On p. 6 a detailed description is given of how the clinical assessments were made by the Liverpool doctor concerned. All other doctors were asked to follow the directions quoted by Dr. Glover. It may be added that a high medical authority has expressed the view that these directions, which give no indication of how the various criteria should be evaluated or combined, are as useful as instructions couched in general terms for writing Shakespearian tragedy. The Board's directions have little or no scientific value, and the "master of the clinical art" does not need them.

Dr. Rhodes has already replied to Dr. Underwood's criticism of the grouping in the Liverpool experiment. I need only add that the doctor in the Manchester experiment, so far from reducing the Board's four alternatives to two, as Dr. Underwood suggests, actually increased them to six.

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* See A. A. Mumford in *Healthy Growth*, Chapters VI and X.

† Some references are given in the White House Report 1.A., p. 243.

‡ H. A. Treadgold, "Functional Efficiency and Body-build in the Young Male Adult," *The Lancet*, ccxxvi, 1377.

Certain speakers have defended the method of clinical assessment. Dr. Daley draws attention to the consistency year by year in the aggregate statistics of nutrition. This consistency, which may be as dangerous as it is remarkable, probably explains why the method of clinical assessment has for so long been accepted as reliable in official quarters. An instructive comparison may be made with the *Examination of Examinations*, on page 15 of which the writers say of one examiner that, statistically, his results on the two occasions were almost identical, but the fate he allotted to half the candidates for the same papers was different. Such superficial "consistency" may be of interest to the psychologist, but clearly it has only delayed the solution of the problem under consideration. Dr. Kantorowitsch quotes me as saying that doctors agree more or less on the diagnosis of children of normal nutrition. Admittedly, doctors agree *best* concerning boys of normal nutrition but, as may be seen from Tables XIX and XXVI, they disagreed over half or more than half the boys said to be normal by one doctor or another. Dr. Glover maintains that there were enough children on the border-line between "satisfactory" and "not satisfactory" to account in great part for the differences between the doctors. This, of course, does not in any way explain the differences of opinion about whether a boy was excellent or slightly subnormal, and differences of this magnitude occurred in 10 per cent. of the cases in some experiments. Apart from this, however, Dr. Glover's claim is interesting, for it implies that more than half the children examined in some areas were on the border-line between satisfactory and unsatisfactory nutrition. If this be true, the returns published in the "Health of the School Child" have indeed given too rosy a view of the state of nutrition of children in this country!

Dr. Magee and others insist that the method of clinical assessment is indispensable. This may be so, but I hope that I may be pardoned for asking Dr. Magee for objective evidence in support of his assertion, especially as many School Medical Officers, in their Annual Reports, have questioned whether the method of clinical assessment is of any real value.

Dr. Glover expresses fear lest readers should get the impression that Tuxford's index is a "golden key" to the assessment of nutrition, and Dr. Daley points out that the index would miss the over-fat, unhealthy child. No extravagant claim is made in the paper for Tuxford's index; on the contrary, in the second paragraph of the Conclusions it is emphasized that this index cannot be regarded as a satisfactory measure of nutrition. The significant point, however, seems to have been missed by some critics, namely, that the index purports to be no more than a rough means of selecting children who require further examination; the only practical alternative is a "rapid review" by a school medical officer. *Since, as a sieve, the index is at least as satisfactory as a careful and complete clinical examination, it will,* a fortiori, *be more satisfactory than any "rapid review."*

Possible alternatives to the method of clinical assessment have been suggested. Dr. Bradford Hill has mentioned a test for vitamin-A deficiency, but, apart from the fact that this test measures only one particular deficiency, even this comparatively speedy test cannot be adopted in practice as a routine measure with large numbers of children. It would be a delusion to hope for salvation in this direction in the near future. Dr. Glover claims that the observation of teachers and others may be relied upon to fill the gaps left by clinical assessment. If, as he suggests, teachers are so successful in picking out children who escape the doctors' scrutiny, one wonders what need there is to employ the doctors at all for this purpose. School Medical Officers will not be flattered, nor the public reassured, by the suggestion that laymen, preoccupied with other duties, are likely to succeed in a task too difficult for trained and experienced medical men.

The Education Act of 1921, which empowers Local Education Authorities to provide free meals for children attending public elementary schools, limits this provision to those children whose parents are unable to pay, and who, by reason of lack of food, are unable to take full advantage of the education provided for them. The Board of Education evidently recognizes the impossibility of determining in any but gross cases whether a child is "unable by reason of lack of food to take advantage of the education provided," and now recommends that extra nourishment be supplied to any child, whose parents are unable to pay, and who shows any symptoms of under-nourishment, however slight. The Board has advanced from "educational" symptoms to "any" symptoms, but since even these are difficult to determine with precision, one may perhaps wonder whether it would not be wise to give up the chase after such a will-o'-the-wisp as the "state of nutrition" and consider other approaches to the problem. For example, free meals or milk or both might be made available for all school-children from families where the *per capita* income falls below a certain level. Alternatively, some English equivalent of the Oslo breakfast scheme might be adopted.

As a result of the ballot taken during the meeting the following were elected Fellows of the Society:—

W. H. Berry.
A. J. Carrington.
A. S. Carruthers.
L. M. Dugdale.
C. A. Gould, M.C.
A. S. Harding.
G. B. Hey.
A. J. Horn.
Jack Howlett.
M. G. Kapadia.
J. P. Kuczynski.
G. G. Leybourne.
L. A. Rothwell.
Josiah Samuel.
T. B. Scott.
A. M. N. Shapei.
Arjan Singh.
S. C. Smith.
M. V. Subba Rao.
A. W. Turner, M.A.
M. Vaidyanathan, M.A.
N. Widdowson.

Edwin Fisher, *representing* Barclays Bank, Ltd.

E. B. Wedmore, *representing* the British Electrical and Allied Industries Research Association.

W. H. Scrivener and H. J. Josephs, *representing* the Post Office Engineering Department.

TRAMP SHIPPING CARGOES, AND FREIGHTS

By L. ISSERLIS, M.A., D.Sc.

[Read before the ROYAL STATISTICAL SOCIETY, December 21st, 1937, the EX-PRESIDENT, PROFESSOR MAJOR GREENWOOD, F.R.S., in the Chair.]

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I PROPOSE to deal with certain aspects only of British shipping.

As regards British shipping as a whole, I shall deal only with the Classification of Shipping owned at certain dates, by type of vessel and trade in which usually employed, and the contribution made to the balance of payments by the earnings of shipping in the foreign trade.

As regards tramp shipping, the paper will deal with the general course of tramp-shipping freights in the sixty-eight years from 1869 to 1936, with the voyages performed, the cargoes carried and freights earned by tramp vessels registered in the United Kingdom in the year 1935, and with the construction of a weighted index number of tramp freights based on the information derived from the analysis of the tramp voyages in 1935.

Section 1. *Introductory*

Some references to writings on these subjects may be of interest. Serious students of the history of merchant shipping will, of course, consult Lindsay's magnificent work, now unfortunately out of print.[1]

The earliest detailed account of the trades in which English ships were engaged must be the early fifteenth century:

> "Libel of English Policie exhorting all England to keepe the sea, namely the narrowe sea; shewing what profite commeth thereof, and also what worship and salvation to England, and to all English-men." [2]

The titles of the first ten chapters may be quoted as giving a summary of usual voyages and cargoes 500 years ago.

1. Of the commodities of Spaine and of Flanders.
2. Of the commodities of Portugal.

3. The commodities of pety Britaine, with her Rovers on the sea.
4. Of the commodities of Scotland and draping of her wolles in Flanders.
5. Of the commodities of Pruce, and High Dutch men, and Easterlings.
6. Of the commodities of the Genuoys and her great Caracks.
7. The commodities and nicetees of the Venetians and Florentines, with their Gallees.
8. Of the commodities of Brabant and Zeland and Henauld and marchandy carried by land to the martes.
9. Of the commodities of Ireland, and policie and keeping thereof, and conquering of wild Irish: with an incident of Wales.
10. Of the commodious Stockfish of Island.

In our own *Journal* the subject is chiefly represented by the series of papers read before the Society at intervals of approximately ten years by the late Sir John Glover, who was a Fellow of the Society for 60 years from 1860 to 1920. His first paper, read in June 1862, was on the Statistics of Tonnage during the first decade 1850–60. The other four papers, read in May 1872, February 1882, March 1892, and January 1902, dealt with the decades 1860–70, 1870–80, 1880–90 and 1890–1900, respectively.

There was no direct reference to freight rates in the first paper, which dealt largely with the misgivings with which shipowners viewed the passing in 1849 of the Navigation Laws Repeal Bill. It may be interesting to quote No. 2 of the Conclusions of that paper—

> "That the increased size of British ships, the increasing economy of labour in their navigation, the greater rapidity in their movements, their increased carrying capacity, and especially the great development of steam tonnage, all show that the obvious means whereby freight might be cheapened with advantage to both carrier and consumer have been diligently and successfully followed by the British shipowner."

The statistical tables consisted of comparisons for the years 1850 and 1860 of the tonnage entered and cleared at U.K. ports, distinguishing tonnage with cargoes from tonnage in ballast, steam vessels from sailing vessels, British vessels from foreign vessels, and vessels engaged in the home trade from vessels engaged in the foreign trade. It was a time of growth, and the argument is based on percentage increases in the various categories.

The misgivings with which the legislation of 1849 were viewed in 1862 had completely disappeared by 1882.

> "It is doubtful whether any of the great economic changes of the last forty years have so completely written into our public records the confutation of its opponents and the justification of the Philosophers and Statesmen who were responsible for it as the Repeal of the Navigation Laws has done."

Sir Robert Giffen took part in the discussion; he pointed out that Glover's statistics of the movement of shipping were confined to entrances and clearances at ports of the United Kingdom. Giffen referred to an investigation on which he was engaged and which would be the subject of a paper at the next meeting of the Society. The work was already leading him to the conclusion that—

> "Our ships were engaged in every sea and were doing business all over the world and our business between foreign countries or between foreign countries and British Colonies exceeded on the whole, he believed, the business done in carrying goods to and from ports of the U.K. itself."

Giffen made on this occasion what must have been his first reference to Invisible Exports, although the word "Invisible" was not used.

> "All these outlays (*i.e.* of shipping) deducting no doubt whatever outlay took place abroad so as to leave only the net balance due to the people of the U.K. constituted a credit of a most important kind to this country in the international account and this credit in fact took the same place in that account as a so-called export."

There was no direct reference to freights in Glover's papers. The first reference to the subject seems to have been in the contribution to the discussion on the 1902 paper made by T. V. S. Angier, who

> "called attention to a deficiency that had struck him and rather surprised him, viz. that Sir John having shown how much our people depended on this great mercantile fleet for their food had made no mention of the food of the ships themselves, *i.e.* freights. The history of freights during all these decades was very interesting. It illuminated many subjects which vitally affected the progress of the fleet as freights were the entire food, so to speak, on which the ships existed. They would not have seen these enormous increases if they had not had occupation for the ships or, in other words, freights for them to earn, and in his opinion, an important statistical Paper might be written tracing the history of the freights by which the ships lived. He had been a very careful follower in Sir John Glover's footsteps, and had gathered from somewhere about the year 1834 a correct and reliable history of the subject."

Angier himself was clearly indicated as the proper person to write a paper on Shipping Freights.

I cannot trace that he ever did.

The excellent yearly reports circulated by Messrs. E. A. V. Angier for the years 1869 to 1919 were, however, separately published in 1920 under the title "Fifty Years Freights".[3] The tradition of publishing an informative and critical analysis of the year's history of tramp shipping is still maintained by the firm.

Ten years before the War the Board of Trade took a hand. In December 1904 there was presented to Parliament (Cd. 2337) a collection of memoranda and statistical tables and charts bearing on British and foreign trade and industrial conditions prepared in the Commercial, Labour and Statistical Department of the Board of Trade in continuation of those contained in the Volume (Cd. 1761) of 1903 presented to Parliament the previous year. It is a most interesting volume. Sir Hubert Llewellyn Smith, in a Prefatory Note, describes the volume as consisting of seventeen Memoranda, some of them divided into several sections, together with two appendices. Two of these Memoranda—"Consumption and Cost of Food in Workmen's Families in Urban Districts in the U.K." and "Changes in the Cost of Living of the Working Classes in Large Towns"—must be familiar to many Fellows of the Society, as they obviously formed the basis for the weighting in the Ministry of Labour's Cost of Living Index Number.

Memorandum No. VIII is entitled "The Course of Ocean Freights during the Past Twenty Years."

Llewellyn Smith says in a Prefatory Note—

> "The Memorandum on the Course of Ocean Freights is entirely based on special enquiries and the resulting Index Number is therefore a fresh addition to the statistical data available on the cost of transport."

In the opening paragraph of the Memorandum we read—

> "In view of the importance of ocean freight rates in the consideration of many questions relating to foreign trade and the almost entire lack of existing data on the subject, it has been thought desirable to institute special enquiries with a view to establishing, so far as possible, the general course of freight rates in the past twenty years."

The material employed in the Memorandum is a combination of liner and tramp freights, the sources drawn upon being Messrs. Angier Brothers' circulars, circulars issued by Messrs. Cairns Noble & Co. of Newcastle, the Year Books of the New York Produce Exchange, and figures specially furnished by two shipping lines.

Mean yearly rates for *inward* freights to the United Kingdom from North America (Atlantic seaboard), South Europe, including Mediterranean and Black Sea, Indian Ocean, Australasia, and *outward* freights from United Kingdom to North America (Atlantic seaboard), North Sea and Baltic, South Europe, including Mediterranean and Black Sea, South America (Atlantic seaboard) and Australasia, are given.

Separate inward and outward index numbers on the basis 1900 = 100 are compiled, the groups of freights being weighted roughly in the proportion of tonnage of British vessels entered with cargoes from the four areas in the case of inward freights and cleared with cargoes to the five areas in the case of outward freights.

The Memorandum comment on the weighting is as follows:—

> "As regards the relative importance attached to the various trades, the system adopted tends to give somewhat undue weight to the shorter voyages. No satisfactory alternative method of weighting has, however, been devised, and it may be observed that a similar calculation based on the simple mean of all the freight rates collected (without any weighting) yields results so generally similar to those obtained by the method explained above as to suggest that exact 'weights' are a matter of comparative indifference."

The number of individual routes employed was 25 for inward rates and 38 for the outward rates. 12 only of the inward rates and 17 only of the outward rates (all referring to coal cargoes) were tramp freight rates, the remaining 13 inward and 21 outward rates, described as rates compiled from figures supplied by a firm maintaining a regular service of vessels in the trade, were clearly liner rates.

The index was thus intended to give at least as much weight to liner rates as to tramp freights. The whole is summarized in the following table :—

TABLE A

Ocean Rates of Freight—Outwards and Inwards

STATEMENT showing the PERCENTAGE FLUCTUATIONS in Mean Yearly FREIGHT RATES between the UNITED KINGDOM and certain Ports Abroad during each of the years 1884–1903 as compared with mean rates for the year 1900. The Percentage Fluctuations in Wholesale Prices of Commodities are added for comparison. (1900 figure = 100.)

Year	Ocean Freight Rates			Index Number of Wholesale Prices of Commodities
	Inward	Outward	Mean of Preceding Columns	
1884	121·7	110·7	116·2	106·1
1885	106·9	101·0	104·0	99·8
1886	98·0	105·0	101·5	94·4
1887	94·6	105·6	100·1	92·2
1888	107·3	114·0	110·7	95·3
1889	125·4	119·2	122·3	97·1
1890	102·8	110·5	106·7	99·5
1891	104·4	95·5	100·0	101·1
1892	84·3	89·3	86·8	96·3
1893	84·8	82·3	83·6	94·6
1894	81·2	78·3	79·8	90·3
1895	74·8	75·7	75·3	86·8
1896	82·8	76·0	79·4	83·9
1897	81·8	84·0	82·9	85·7
1898	96·5	88·9	92·7	88·5
1899	83·7	91·7	87·7	89·5
1900	100·0	100·0	100·0	100·0
1901	69·1	80·8	75·0	95·2
1902	65·2	76·1	70·7	94·7
1903	66·6	78·9	72·8	94·4

I cannot finish this historical note without referring to Mr. Macrosty's valuable paper on the Statistics of British Shipping read before our Society in April 1926. It covered a very wide field, and I expressed at the time my appreciation of the excellence of the picture presented of the state and activity of British shipping. For my present purpose it will suffice to recall that he summarized the Board of Trade calculations of the contribution of shipping earnings to the balance of trade ranging from £385 million in 1920 to £138 million in 1925, and prepared a weighted yearly freight index, with the year 1920 as base, for the years 1923, 1924 and 1925. The material used consisted of the average freight rates given in the annual reviews of the *Daily Freight Register*, and the weighting was based partly on the volume of tonnage of British ships cleared with coal cargoes or entered with timber cargoes, and partly on the weights of certain commodities imported into the U.K., and the entrances with cargo from the areas roughly corresponding to these cargoes.

I had made myself responsible for an index number of tramp freights at the Chamber of Shipping in 1920, and Mr. Macrosty gave the following comparison of his weighted index with the Chamber of Shipping Index for the three years:

	1920	1923	1924	1925
Chamber of Shipping Index Number	100·00	28·4	29·6	25·3
Weighted Index Number	100·00	28·03	28·80	27·56

Mr. Macrosty remarks:

> "The Chamber of Shipping Index Number was higher than the weighted index number by 1·3 per cent. in 1923, and by 2·8 per cent. in 1924, and was lower by 8·2 per cent. in 1925; the differences are not excessive, except in the last year, and it may be only a coincidence that they have increased each year."

Section 2. Classification of Shipping.

Official statistics of shipping in this country are very full, but omit many important subjects. The vessels on the Register are classified by size, age and method of propulsion. Some information is given as to the vessels with the persons employed on them, employed in the home trade and in the foreign trade, respectively, on one day in the year and employed some time during the year, but it is not possible from the official records to classify British ships more closely according to type of vessel or according to the kind of trade in which the vessel is normally employed, nor do the official records give any indication of the earnings of ships or of the course of freights. For these purposes recourse must be had, so far as freights are concerned, to the unofficial records in trade publications such as the *Daily Freight Register*, but as regards classification of ships by category or by the trade in which they are employed, and as regards the earnings of shipping, recourse must be had to direct enquiry from shipping companies themselves. It may be that some day the census of production will be extended to cover not only the production of goods, but also the production of services, and that shipping will be included in the census. Voluntary enquiries are necessarily fraught with great difficulties. Replies to such enquiries are almost necessarily incomplete, and there is always danger that the answers received refer to a self-selected population.

Four voluntary Enquiries—two dealing with the Classification of Shipping owned in the United Kingdom and two dealing with the contribution of such shipping to the balance of international payments—have been conducted by the Chamber of Shipping of the United Kingdom in recent years. The Classification of Shipping Enquiries were undertaken in 1933 and in 1936. In the first of these, shipowners were asked to classify the tonnage owned by them on October 1, 1933, on June 30, 1929 and on June 30, 1914. Ownership in 1933 did not coincide with ownership in the earlier years, and the replies received accounted for 67·7 per cent. of the gross tonnage owned in 1914, 83·9 per cent. of that owned in 1929 and 86·2 per cent. of the tonnage owned in 1933. In the second Enquiry the same information was asked for in respect of June 30, 1936, and the replies received accounted for 87·8 per cent. of the relevant gross tonnage on the United Kingdom Register on that date. The results are summarized in Tables I, II, III, and IV of the Appendix. As regards October 1, 1933, and June 30, 1936, it was practicable to fill the gaps of 13·8 per cent. and 12·2 per cent. almost completely by further Enquiry and by the use of Shipping Directories and other works of reference. Tables V and VI represent the result of inserting the additional information so obtained in Tables III and IV. These tables classify the merchant shipping of the United Kingdom according to type of vessel and according to the kind of trade in which the vessel is normally employed. These classifications overlap to a certain extent; a tanker, for example, or, to give it its full title, a vessel fitted for the carriage of petroleum in bulk, is in a class by itself as regards type, and is necessarily limited to the carriage of liquid cargoes. It can, however, be employed solely in the coasting trade or in the foreign trade, or partly in the one and partly in the other. If employed solely in the coasting trade, it is a part of the system of internal transport. Similarly, a cargo vessel may be employed in the coasting trade or in the foreign trade, or in both; but in whichever of these trades it is employed, it may run to a schedule on a regular line offering to carry various kinds of merchandise in parcels at tariff rates on fixed routes calling at fixed ports; it is then a cargo liner. It may, on the other hand, offer in a restricted or unrestricted field to carry full cargoes of a commodity such as grain, ore, timber, etc., between any two points for the convenience of the merchant who charters the vessel for the purpose. It may even be hired out to the charterer at a time rate, in which case, subject to conditions specified in the charter-party, the charterer may load any cargo he pleases, and again, subject to the conditions of the charter-party, employ the vessel for carrying the cargo between any ports he chooses. Such vessels are known as tramps. They do not necessarily differ in type from vessels employed as cargo liners, but in practice the owner, the naval architect and the shipbuilder, when a new vessel is laid down, do have regard to the trade in which it is intended that the vessel should be employed. A tramp usually requires a very full supply of cargo-handling equipment, as it may be sent to ports in which the shore equipment is deficient. A cargo liner calling always at the same ports, and very often making use of regular berths at those ports, may be in a position to rely on the cargo-handling facilities which the owner knows exist there, and which he may even have provided himself at the berth he owns or rents. The liner may be equipped for the carriage of passengers as well as of cargo, and the relative importance of cargo and passengers may vary. Certain perishable cargoes need the provision of refrigerated space, and many cargo and passenger liners are therefore fitted with refrigerating appliances.

There is no precise dividing line between the tramp and the cargo liner, or between the cargo liner and the passenger liner. A passenger-carrying certificate is required when more than 12 passengers are to be carried. Vessels provided with such certificates may, like the Mauretania or Queen Mary, devote almost the whole of their earning capacity to the carriage of passengers and mails, or, like many of the vessels trading to the East, concern themselves more or less equally with the carriage of both cargo and passengers. The distinction in the tables between passenger liners and mixed cargo and passenger liners is thus somewhat vague, and a few owners dealt differently with their fleets in 1933 and in 1936. The most difficult distinction to make is that between the tramp ship and the cargo liner. It may be thought that a precise statutory distinction would be found in the British Shipping (Assistance) Act 1935, which provided a subsidy to help tramp shipping. The draughtsman gave the task up in despair. The Act contains certain eliminating words. By Section 6 (1) " the vessels to which the Act applies are ships which are neither fishing vessels nor constructed or adapted for the carriage of liquid cargoes in bulk, nor so constructed or adapted that the space insulated for the carriage of special cargoes is in excess either of 50,000 cubic feet or of 10 per cent. of the total space available for cargo." Recognizing that the same ship may be sometimes employed as a tramp ship and sometimes as a cargo liner, Parliament preferred to define a tramp voyage, which, according to Section 6 (2) " means a voyage in the course of which all the cargo carried is carried under charter party but does not include any voyage during any part of which more than twelve passengers are carried."

Replies to the 1936 Enquiry were no doubt influenced to some extent by the new conditions created by the passing of the Act of 1935, and for an accurate comparison of the distribution of shipping in 1933 and 1936 it is necessary to combine tramps and cargo liners in one group. If passenger liners and mixed passenger and cargo liners are also combined into one group, the distributions on the two dates are as shown below :

TABLE B

Classification of United Kingdom Tonnage on October 1, 1933, *and June* 30, 1936

	October 1, 1933		June 30, 1936	
	No.	Gross tons	No.	Gross tons
TRAMP AND CARGO LINERS				
Coasting and Home Trade (1), (2), (3)	854	661,428	1,014	768,379
*Foreign Trade (4) and (5)	2,048	9,275,629	1,854	8,800,987
Total (1), (2), (3), (4), (5)	2,902	9,937,057	2,868	9,569,366
PASSENGER AND MIXED PASSENGER AND CARGO				
Coasting and Home Trade (1), (2), (3)	300	319,339	208	288,931
*Foreign Trade (4), (5)	494	4,506,137	384	3,887,541
Total	794	4,825,476	592	4,176,472
TANKERS				
Coasting and Home Trade (1), (2), (3)	28	14,524	38	44,151
*Foreign Trade (4), (5) and Admiralty Tankers	373	2,227,868	365	2,166,580
Total	401	2,242,392	403	2,210,731
OTHER TYPES	146	101,069	77	66,772
NON-TRADING	2,620	825,000	2,732	749,417
BALANCE not analysed	621	457,719	360	349,007
TOTAL ON UNITED KINGDOM REGISTER	7,484	18,388,713	7,032	17,121,765

* Including vessels employed partly in the home and partly in the foreign trade.

The total on the Register on June 30, 1936, showed a reduction of 452 vessels of 1,266,948 gross tons compared with the total on October 1, 1933. To this reduction tramps and cargo liners in the foreign trade contributed 194 vessels of 474,642 gross tons, and passenger and mixed passenger and cargo vessels in the foreign trade contributed 110 vessels of 618,596 gross tons.

A classification of the tonnage owned in Great Britain on December 31, 1935, on similar lines to the above was supplied by the Mercantile Marine Department of the Board of Trade to the International Labour Office for insertion in the *Maritime Statistical Handbook*, published by the I.L.O. in 1936 (Table 2, page 160) on page 62.

It is interesting to compare this return with Table VI. According to the latter, 875 vessels of 3,821,288 gross tons were "usually engaged" as tramps in the foreign trade, and 828 vessels of 4,623,175 gross tons were "usually engaged" as cargo liners in the foreign trade, while according to the former, 1,026 vessels of 4,375,037 gross

TABLE C

December 31, 1935

Nature of Service	Ships Engaged in Foreign Trade		Ships Engaged in Home Trade		Ships Engaged in Coasting Trade		Total	
	No.	Total g.t.	No.	Total g.t.	No.	Total g.t.	No.	Total g.t.
Tramps	1,026	4,375,037	328	271,159	180	211,131	1,534	4,857,327
Cargo Liners	781	4,367,953	104	107,501	55	49,459	940	4,524,913
Combined Cargo and Passenger	330	2,809,300	33	51,111	45	66,733	408	2,927,144
Passenger	43	874,200	43	93,395	62	66,520	148	1,034,115
Tankers	287	1,844,285	16	11,526	12	9,004	315	1,864,815
Total	2,467	14,270,775	524	534,692	354	402,847	3,345	15,208,314

tons were on foreign-trade tramp voyages and 781 of 4,367,953 gross tons were on foreign trade cargo liner voyages on December 31, 1935. The totals for tramps and cargo liners combined about 1,700 vessels of 8,444,000 gross tons in Table VI, and about 1,800 vessels of 8,743,000 gross tons in the *Maritime Statistical Handbook* are not very different, such difference as there is being possibly accounted for by some of the 126 tramp vessels and 25 cargo liner vessels of 207,064 gross tons and 149,460 gross tons, respectively, " usually engaged " partly in the home and partly in the foreign trade, being employed in the foreign trade on December 31, 1935.

The tables will, I hope, be found useful. Space will not permit of more than one illustration. The question is often asked " What is the carrying capacity of a ship or a fleet of ships of a specified net tonnage ? " It will be recalled that the gross tonnage of a ship is roughly measured by the number of 100 cubic ft. spaces enclosed, and that the net tonnage is a corresponding number reached after deducting certain exempted spaces needed to house machinery and crew, etc. The deadweight tonnage of a ship, on the other hand, is intended to represent the number of tons weight of cargo and bunkers that the ship can carry. This last figure must itself vary with the nature of the voyage and the nature of the cargo. A deeper draft is permitted to vessels almost all over the world in summer than in winter. A dense cargo, such as iron ore, will bring the vessel down to her marks before all the holds are filled. A light cargo, on the other hand, may fill the ship without bringing her down to her marks. The deadweight, as understood by the shipowner and shipbuilder, usually means the maximum weight of cargo, stores and fuel that the vessel can safely load under the most favourable conditions.

A rough-and-ready rule in common use for many years was 100 net tons = 160 gross tons = 240 deadweight tons.

The following table shows the actual equivalents in gross tons and deadweight tons corresponding to 100 net tons for the various classes of merchant vessels engaged in the coasting and in the foreign trade at the four dates covered by the Enquiries. The figures in parentheses indicate the numbers of ships on which the equivalents are based.

TABLE D

Gross Tons and Deadweight Tons to 100 *Net Tons*

	June, 1914		June, 1929		Oct., 1933		June, 1936	
	gr.	d.w.	gr.	d.w.	gr.	d.w.	gr.	d.w.
TRAMPS:								
(1) Coasting Trade	(423) 180	257	(425) 190	268	(501) 190	268	(620) 196	269
(2) Foreign Trade	(896) 160	264	(908) 163	274	(865) 163	278	(950) 164	281
CARGO-LINERS:								
(1) Coasting Trade	(179) 201	225	(238) 210	273	(220) 214	272	(244) 219	260
(2) Foreign Trade	(1035) 157	247	(1062) 161	222	(955) 161	238	(823) 163	233
PASSENGER LINERS:								
(1) Coasting Trade	(32) 269	—	(24) 243	—	(33) 245	—	(52) 212	28
(2) Foreign Trade	(42) 178	134	(74) 180	110	(66) 181	103	(44) 172	89
MIXED CARGO AND PASSENGER LINERS:								
(1) Coasting Trade	(170) 206	166	(82) 222	157	(67) 226	140	(88) 226	92
(2) Foreign Trade	(510) 163	165	(416) 166	154	(341) 167	155	(283) 171	148
TANKERS:								
(1) Coasting Trade	(3) 219	235	(22) 211	215	(27) 211	226	(37) 181	205
(2) Foreign Trade	(112) 157	234	(312) 165	238	(313) 166	252	(307) 169	256
ALL TYPES OF VESSELS:								
(1) Coasting Trade	(807) 195	217	(791) 204	240	(848) 204	241	(1041) 209	217
(2) Foreign Trade	(2595) 161	223	(2772) 164	213	(2540) 165	223	(2407) 166	224
(3) Coasting and Foreign Trade	(3402) 102	222	(3563) 166	214	(3388) 166	223	(3448) 168	224

It will be seen that in one or two cases, such as Coasting Trade Tankers in 1914, the numbers are too small for significance to be attached to the results, but reliance can be placed on certain broad deductions. A ship pays port dues, light dues, Suez and Panama Canal dues on her net register tonnage (measured according to special rules in the case of the canals), and owners and naval architects constantly strive to increase the earning capacity of the ship for the same dues-paying space. The deadweight—that is to say, the freight-earning capacity of foreign-going tramps for each 100 net tons—has steadily risen from 264 tons in June 1914 to 281 tons in June 1936. Cargo liners, on the other hand, owing to the necessity of providing refrigerated cargo space and additional space for propelling machinery because of the higher speeds expected, have now smaller earning capacity—233 tons, as compared with 247 tons in 1914 per 100 net tons. The most striking departure from the the rough 5–8–12 rule is shown in the case of passenger liners whose earning capacity in 1936 was less than 100 d.w. tons per 100 tons net. For tankers engaged in the foreign trade there has been a similar increase to that for foreign-going tramps; from 234 d.w. tons in 1914 to 256 d.w. tons in 1936. The International Convention providing for the international enforcement of the load line was ratified by this country in 1932, and as a result tankers registered in the United Kingdom have, following what was shown to be a safe practice in American and other experience, been allowed to sail with less freeboard. This obviously explains the 6% increase from 238 d.w. tons per 100 tons net in 1929 to 252 d.w. tons in 1933.

Section 3. *Invisible Exports : Contribution of Shipping to the Balance of International Payments.*

Sir Robert Giffen, in a paper read to our Society in 1882, pointed out that imports and exports of merchandise are only a part of the whole account between nations, that other very important items enter into the account, one of which is the earnings of the shipping fleet of England, the cost incurred in getting these earnings being in truth quite in the nature of an export as far as the question of the balance of trade is concerned. "If we send a ship to carry goods between one port and another, the people who sail the ship and who convey the coals which are put on board of it are as much exporters in the proper sense of the word as the people who send away cotton goods or machinery and other articles for sale abroad. The service which the shipowner renders has in fact to be paid for as well as the commodity which the merchant exports, and the two are, for the purposes of an account of the balance of trade, clearly to be put in the same category." [4]

The extent to which the export of shipping services is included or not in a country's foreign trade statistics depends on the method of valuation adopted in that country's foreign trade returns. In our trade statistics, imports are valued c.i.f., cost, insurance, freight, *i.e.* "the value of imports represents the price which an importer would give for the goods on a purchase in the open market if the goods were delivered to him at the port of importation, freight, insurance, commission, and all other costs, charges and expenses incidental to the purchase and delivery at that port (except any duties of Customs) having been paid." It follows that if goods imported from a foreign country are brought home in a United Kingdom ship, our indebtedness to foreign countries is over-stated, as that part of the total payment due for the goods represented by freight is due to a United Kingdom resident. Our exports, on the other hand, are valued f.o.b., and "the value of exports represents the cost of the goods to the purchaser abroad, including packing and all other relative charges, up to the time of their delivery on board the exporting vessel, and is known as the 'free on board' value." If, therefore the exports go in a British ship, the payment due to us from the foreign purchaser is under-stated. He owes this country the freight in addition to the f.o.b. value. The net credit contribution of the British ship to the credit side of our balance of payments is clearly, in these two cases, the difference between the gross freight earned and the expenses incurred by the ship in foreign ports. There is, however, a third important case. When a United Kingdom ship carries goods from China to Peru, there is also an export of shipping services. Residents in foreign countries incur a debt to the United Kingdom, of which there is naturally no trace whatever in our foreign trade statistics. The net contribution to the credit side of our balance of payments is, in this case, rather smaller, as the British ship incurs expenses both in China and in Peru. There are in all three cases as a rule intermediate expenses : the cost of stores, repairs, bunkers, canal dues and so forth incurred by the ship at foreign ports during her voyage.

For many years the Statistics Department of the Board of Trade has, in its yearly article on the Balance of Payments, included an estimate of the contribution of shipping to what Giffen happily named "Invisible Exports."

In February 1932 Mr. Walter Runciman, now Viscount Runciman of Doxford, then President of the Board of Trade, reminded the President of the Chamber of Shipping that the preparation of an annual estimate of the balance of trade is one of the tasks of the Board, that the Shipping Industry makes an important contribution to the credit side of the account, and that if this contribution could be accurately assessed, it would obviously increase the value of the Board's estimates. He suggested that the Chamber should develop and establish a scheme which would provide year by year a reliable estimate of this kind, and place the results at the disposal of the Board of Trade.

The Chamber circulated to its members in respect of the year 1931 the Questionnaire shown below as Table E (p. 66).

Owners were asked to give particulars under Question 4(*a*) and (*b*) of the trade between different countries as far as possible separately, *e.g.* United Kingdom—Australia, China—U.S.A., India—Holland, etc.

The Enquiry was the first of its kind, and the response from members of the Chamber and of the Liverpool S/S Owners' Association was gratifying. The four Railway Companies who are themselves important shipowners also contributed their figures.

Replies were received in respect of 11·4 million gross tons of shipping out of a possible total of 17·4 million gross tons. The owners of 7·6 million gross tons supplied detailed information with reference to trade between individual countries. The results of the

TABLE E

Invisible Exports: Contribution of Shipping Industry

NOTE.—The export of shipping services is represented by the amount by which gross receipts (see 4 (*a*) in the Table below) exceed expenses abroad (see 4 (*b*) and 5 below). It has, of course, no relation to profits, particulars of which are not relevant to this enquiry.

(1) Service.

(2) Period covered by the Return. Preferably Calendar Year 1931. (If it is not practicable to make the Return for the Calendar year, the Return may be made for a period of 12 months including as much as possible of the Calendar year 1931. The precise period should be stated.)

(3) Fleet.	First day of period		Last day of period	
	No.	Gross Tons	No.	Gross Tons
Ships owned or managed				
Ships actually trading ...				

(4) (*a*) Total Gross Receipts and (*b*) Total Expenses in Foreign trades giving where possible separately the trade between pairs of countries, *e.g.* U.K. and Australia, India and U.S.A., etc.			(*a*) Total GROSS RECEIPTS under all heads during the period from trading between the United Kingdom and ports abroad and in the trade between ports abroad (including in both cases ports in the Irish Free State)	(*b*) TOTAL EXPENSES abroad during the period
	Name of Country	Name of Country	£	£
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
...				
...				
...				
...				
Total				

(5) Expenses incurred abroad in connection with any vessels laid up in ports abroad during the period.

Additional forms will be supplied on request.

Enquiry were summarized in tables sent to the Board of Trade. One, on which important details of the estimate were based, had necessarily to be confidential, as a line-by-line comparison would indicate the relative gross income per ton of shipping engaged in different types of trade.

The final estimate based on the Returns, sent to the Board of Trade in December 1932 was that the gross earnings of British shipping employed in the foreign trade, less expenditure abroad, amounted in 1931 to nearly £73 million. The Chamber of Shipping and the Statistics Department of the Board of Trade had reached an estimate of about £70 million in February 1932. The Board of Trade estimate as published in the *Board of Trade Journal* for February 18 was £80 million, but this included an estimated expenditure of £9 or £10 million by foreign ships in British ports. It appeared, therefore, that such estimates had in the past been made on sound lines, and in so far as they had been reached by noting alterations in conditions from year to year, it was hoped that the new figure of £73 million for the year 1931 would supply a proper basis for estimation for some years to come.

The total excluded, so far as was practicable, the earnings of British ships from passage money paid by residents of the United Kingdom in travelling on United Kingdom business or for their own pleasure. In particular the earnings from holiday cruises were excluded.

One of the summary tables * analysed for 1931 more than half of the estimated total gross earnings of British shipping employed in the foreign trade. It shows that in 1931, 48·7 per cent. of the gross receipts of this sample was earned in inter-Imperial trade, including the United Kingdom, and 51·3 per cent was earned in voyages where a foreign country was involved at one or both ends. In particular, 10·7 per cent. of the gross receipts was earned in carrying between foreign countries. The year 1931 was not a typical year for the purpose of such an analysis. The trade of many foreign countries was abnormally depressed, and much tramp and cargo liner shipping which normally carries between one foreign country and another foreign country was laid up, and it is probable that the 10·7 per cent. in line FF is lower than is the case in normal years.

In any comparison of the total of £73 million with earlier years it should be remembered that trade between the United Kingdom and the Irish Free State is included. In 1931 the contribution to gross earnings under this head was £946,000 and to net earnings £723,000. In estimates of invisible exports prior to 1923, trade with the Irish Free State would of course have been coasting trade of the

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* See Table G, page 70.

United Kingdom. The main lines of the estimate for 1931 were as follows:

TABLE F

Invisible Exports 1931. *Contribution of Shipping Industry*

Results of Enquiry made by Chamber in reponse to request of President of Board of Trade

(Figures collected by the Liverpool Steam Ship Owners' Association and figures supplied by the Railway Companies have been incorporated in the totals.)

A. Summary of replies to Questionnaire issued by Chamber of Shipping.

	Ships Owned or Managed		Ships Actually Trading	
	No.	Gr. Tons	No.	Gr. Tons
January 1, 1931	2,366	11,735,793	1,976	10,208,825
December 31, 1931	2,309	10,989,682	1,904	9,257,118
Average, say, ...	2,337	11,362,738	1,940	9,732,972

	Total Gross Receipts from employment in foreign trade in 1931 ...	£101,073,851
	Total expenses in foreign ports (including £90,953 lay up expenses) ...	45,605,637
	Total Net Receipts	£55,468,214
B.	Owners who made no return owned on June 30, 1931, 1,584 trading ships of 5,999,357 gross tons. An estimate has been prepared for each of eight classes of tonnage in respect of which no returns have been received, based on the returns made in respect of corresponding classes. This estimate yields:	
	Estimated Gross Receipts ...	£43,682,000
	Estimated expenses abroad ...	19,396,000
	Estimated Net Receipts ...	£24,286,000
C.	Combining A and B the following estimate is obtained in round figures:	
	Ships owned June 30, 1931. No. 3,931. Gr. tns. 17,362,095 — Gross Receipts	£144,756,000
	Ships owned June 30, 1931. No. 3,931. Gr. tns. 17,362,095 — Expenses abroad...	65,002,000
	Net Receipts	£79,754,000
D.	From Returns made by the chief passenger lines (including the Railway Companies) and from estimates based on these returns as regards other passenger lines it is estimated that the deduction to be made for passage money paid by U.K. passengers is	£6,915,000
	Leaving as a balance	£72,839,000, or, say, £73,000,000.

TABLE F (*continued*)

E. The estimate in the C/S Annual Report for 1931–32 was £70,000,000 and the estimate made by the B/T was £80,000,000. The B/T estimate included a sum of about £10,000,000 for the expenditure of foreign ships in United Kingdom ports.

F. As shown in (C) the estimate applies in round figures to 17,400,000 gross tons owned on June 30, 1931.

The total tonnage owned in Great Britain and Ireland as recorded in Lloyds Register was 20,200,000 gross tons.

The difference of 2,000,000 gross tons consisted as to 1,100,000 gross tons of ships which are not traders, such as fishing vessels, boats owned by Dock and Harbour Authorities, etc., and as to the remainder, consisted of vessels engaged solely in the coasting trade of the United Kingdom and of vessels owned in the Irish Free State.

G. Allowing for the fact that parts of the total have been estimated, the final figure may be considered as almost certainly lying between the limits of

£71·0 million and £74·6 million,

and very probably between

£72·2 million and £73·4 million.

The owners of 7·6 million gross tons of shipping gave the particulars asked for, country by country, in Question 4. From these, 41 folio pages of tables were prepared showing the detailed distribution of the earnings of this tonnage. A line taken at random, for example, from these tables showed that the owners of this tonnage earned in 1931 £109,852 in carrying between France and the United States, and that in earning this freight they incurred expenses, £34,463 in France and £37,146 in the United States, leaving a net contribution to the United Kingdom balance of payments of £38,243.

I have space only for the following broad summary in which UE denotes shipping trading between the United Kingdom and Empire countries outside the United Kingdom; EE denotes shipping trading away from the United Kingdom between Empire countries and Empire countries; UF shipping trading between the United Kingdom and foreign countries; EF shipping trading between Empire countries and foreign countries, and FF denotes shipping trading between foreign countries in either direction.

While the replies to a first and voluntary Enquiry of this kind were considered gratifying, it will be noted that replies were only received in respect of 11·4 million gross tons out of a possible 17·4 million gross tons and detailed replies were received only in respect of 7·7 million gross tons, or 43·7 per cent. of the possible total. It was therefore not safe to make estimates for the trade between individual countries by increasing the figures in the ratio of 100 to 43·7, except perhaps in cases such as trade with Argentina, where the totals were large. A defect in the 1931 Questionnaire was that the two directions were not separately distinguished. In the illustration quoted, carrying from the United States to France was aggregated

TABLE G

Gross Earnings of British Shipping in Foreign Trade, 1931

Chamber of Shipping Inquiry

(A) Replies showing details of routes.

	Gross Tons, millions	Gross Receipts, £ millions	Expenses Abroad, £ millions	Net Receipts, £ millions
UE	7·6	27·9	10·6	17·3
EE		7·7	4·8	2·9
UF		21·2	7·4	13·9
EF		8·5	5·0	3·6
FF		7·8	4·1	3·7
Miscellaneous ...	—	0·3	0·1	0·1
		73·4	31·9	41·5
(B) Replies not showing details ...	3·8	28·0	13·7	14·3
Total	11·4	101·1	45·6	55·5
(C) Not replied ...	6·0			
	17·4			
United Kingdom Coasting	1·1			
Not Traders	1·7			
Total on Lloyds Register	20·2			

Details in (A) (omitting Miscellaneous) as Percentages.

	Gross Receipts, %	Net Receipts, %
UE	38·2	41·9
EE	10·5	7·0
UF	29·0	33·6
EF	11·6	8·5
FF	10·7	9·0
	100·0	100·0

with carrying from France to the United States. The task of repeating the Enquiry annually was considered to be too great both for the limited resources of the Chamber and for the patience of its members, but the Enquiry was repeated this year in respect of the earnings of British shipping engaged in the foreign trade in the year 1936.

After consultation with the Statistics Department of the Board of Trade, a Questionnaire (Table H) was agreed, which differs from the 1931 Questionnaire in certain respects.

Owners were asked to distinguish direction of trade, to give the passage money earned, distinguishing between residents and non-residents of the United Kingdom, and to give information with respect to cruising ships, as cruising ships had become an increasingly important factor since 1931. A third column was also inserted under the heading "Expenses," so as to show separately the expenses incurred en route.

A very much fuller and more detailed response has been received to the 1936 Enquiry, corresponding to over 90 per cent. of the tonnage employed in the foreign trade.

The work involved in the case of a big shipping company in preparing these returns is considerable. In one case several members of the staff were occupied full time for a couple of months. In another case the company borrowed two clerks from its auditors for a period of three months in order to complete the return.

Returns were received from the owners of 13·75 million gross tons out of a possible total of 15·10 million gross tons, or 91 per cent. Detailed information with reference to the trade between individual countries was given in respect of a little over 11 million gross tons. The total gross earnings, in the foreign trade, of the 13·75 million gross tons, from freight and passage money (including cruising fares) paid by non-residents of the United Kingdom, amounted to £120·67 million, the total expenses abroad to £51·89 million, so that the net receipts forming the contribution of these 13·75 million gross tons, to the credit side of the balance of payments, was £68·78 million. Applying appropriate ratios derived from the different types of ships included in the 13·75 million gross tons to the ships of the same types in respect of which no returns were received, a final estimate of £74·8 million was reached for the whole of the 15·1 million gross tons employed in the foreign trade in 1936. This total is only £2 million higher than the total in 1931. On this occasion the Chamber of Shipping estimate made in February 1936 was £80 million, and the Board of Trade estimate even higher. Between 1931 and 1936 there had been important changes—shipping owned had fallen by about 2½ million gross tons, idle shipping was reduced by about the same amount, tramp freights rose by nearly 15 per cent., but the freights earned by liners and tankers had fallen. The error in the "intercensal" estimate shows the value of the periodical census. The total of nearly £75 million is made up in various proportions by earnings on voyages to and from the United Kingdom, Empire countries and foreign countries.

Nearly 80 per cent., £96 million out of £121 million of the gross receipts covered by the returns for 13·75 million gross tons, and the corresponding net receipts after deducting expenses abroad, can be analysed in detail according to direction of trade.

In the following table, United Kingdom ports are denoted by U; foreign ports by F and British Empire Ports outside the United

TABLE H

Form to be returned to CHAMBER OF SHIPPING of the UNITED KINGDOM, 28 St. Mary Axe, E.C.3.

ANSWERS WILL BE RECEIVED IN STRICT CONFIDENCE.

INVISIBLE EXPORTS: CONTRIBUTION OF SHIPPING INDUSTRY.

NOTE.—The export of shipping services is represented by the amount by which gross receipts exceed expenses abroad. It has, of course, no relation to profits, particulars of which are not relevant to this enquiry.

(1) Name and Address of Firm.

(2) Period covered by the Return—this should be the Calendar Year 1936. (If it is not possible to make the Return for the Calendar Year, the Return should be made for a period of 12 months including as much as possible of the Calendar year 1936. The precise period should be stated.)

(3) Fleet.	First Day of Period		Last day of Period	
	No.	Gross Tons	No.	Gross Tons
Ships owned or managed				
Ships actually trading				

(4) Total Gross Receipts during the period and Total Expenses outside the United Kingdom.

TRADING SHIPS								CRUISING SHIPS	
Total *Gross Receipts* during the Period from Trading between the United Kingdom and Ports Abroad and between Ports Abroad (Treating in both Cases Ports in the Irish Free State as Ports Abroad).					Total *Expenses* Incurred Abroad during the Period			Passage Moneys paid by (*a*) residents and (*b*) *non*-residents of the United Kingdom (*a*) £ .... (*b*) £	
From Name of Country *	To Name of Country *	Freight £	Passage Moneys paid by (*a*) residents and (*b*) *non*-residents of the United Kingdom £		In Country named in Col. (1) £	En route, *e.g.*, Suez and Panama Canal Dues or at bunkering ports abroad, etc. £	In Country named in Col. (2) £	Expenses incurred in ports abroad, in Name of Country	£
(1)	(2)	(3)	(4) (*a*)	(*b*)	(5)	(6)	(7)	(8)	(9)

* Please give *Countries* not *Ports*.

Continuation sheets will be supplied on request.

Kingdom by E, UF means earnings on voyages from U.K. ports to foreign ports; FU means earnings on voyages from foreign ports to U.K. ports, and so forth.

TABLE I

Analysis of Receipts in respect of 11·1 *million gross Tons of Shipping*

	Gross Receipts 1936		Net Receipts (viz. Gross Receipts less expenses incurred abroad) 1936	
	£ million	%	£ million	%
UF	7·22	7·5	4·68	8·2
FU	16·96	17·7	12·13	21·3
UF + FU	24·18	25·2	16·81	29·6
UE	12·40	12·9	7·97	14·0
EU	24·81	25·9	15·99	28·1
UE + EU	37·22	38·8	23·96	42·1
EE	7·43	7·7	2·64	4·6
EF	6·85	7·1	3·36	5·9
FE	6·17	6·4	2·70	4·7
EF + FE	13·02	13·6	6·06	10·7
FF	14·07	14·7	7·39	13·0
Total	95·91	100·0	56·86	100·0

3. The similar analysis in 1931 dealing with 7·6 million gross tons, £73·4 million gross receipts and £41·5 million net receipts, was:

	Gross Receipts 1931	Net Receipts 1931
	%	%
UF + FU	29·0	33·6
UE + EU	38·2	41·9
EE	10·5	7·0
EF + FE	11·6	8·5
FF	10·7	9·0
	100·0	100·0

Comparing 1936 with 1931, the contribution of FF trade to the gross receipts increased from 10·7 per cent. to 14·7 per cent., and the contribution to the net receipts increased from 90 per cent. to 13 per cent. Improvement in world trade caused, as anticipated on page 67, a greater demand for the services of British shipping in the carrying trade between foreign countries.

Section 4 (*a*) *Tramp Shipping Freights*, 1869–1936.

I have referred earlier to the Annual Reports circulated by Messrs. Angier Brothers from 1870 to 1909, and since then by E. A. V. Angier. These give the highest and lowest freights on over 200 homeward and over 100 outward routes since 1869. The year 1869 witnessed the opening of the Suez Canal, and forms a convenient starting-point in a review of freight rates during modern times. During the sixty-eight years covered by the figures there have been great changes in the type of vessel, the method of propulsion, the distribution of routes and the nature of cargo carried. It is clearly impossible to compare directly the freight in 1869 paid to a sailing vessel carrying grain from Odessa to the United Kingdom with a freight in 1936 payable to a modern motor ship for carrying grain from Montreal or New York to Liverpool. I have therefore adopted a chain method, in which the freights in 1870 are compared with freights in 1869, freights in 1871 with freights in 1870, and so forth, ending with a comparison of freights in 1936 with freights in 1935. In two consecutive years conditions are sufficiently stable and comparable routes are sufficient in number for the determination of a satisfactory ratio index. The whole of the routes and the yearly comparisons of the freight on any route with the freight on the same route in a preceding year are shown in Table VII in the Appendix. As the " average " rates were not given, I have had to follow the precedent set by the Board of Trade Memorandum of 1903, and have taken the mean of the highest and lowest rates for each year as representing the course of freights in the year. The method has obvious dangers when applied to individual routes, but, as will be seen later, gives as a rule very nearly the same result for the general index number based on all routes as when an unweighted average of average rates is employed. It is apt to be misleading in a year such as 1915, when freights trebled as compared with the year before, or in a year such as 1920, when freights fell by more than 50 per cent. during the course of the year.

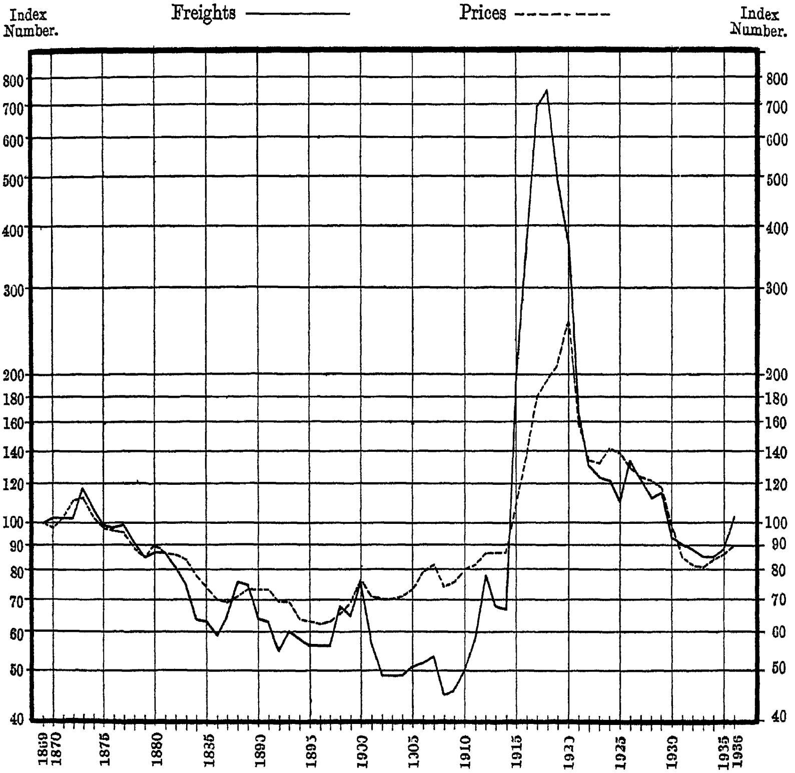
Table VIII gives the values of the freight index numbers and of the *Statist* index number of wholesale prices for the years 1869 to 1936 to base 1869 = 100, the general trend for each as shown by a seven-year moving average, the absolute deviations from the general trends and the deviations for each year expressed as percentages of the general trend values for that year.

Chart 1 shows, on a ratio scale, the course of freights and prices during the period. Chart 2, also on a ratio scale, shows the general trends, and Chart 3 the deviations of freights and prices from the general trends as percentages of the general trend values.

The prewar maxima and minima of the freight index numbers (1869 = 100) were as follows:

1873	117	1898	68
1879	85	1899	65
1881	87	1900	76
1886	59	1904	49
1888	76	1907	54
1892	55	1908	45
1893	60	1912	78
1895	56		

Chart 1.—Tramp Shipping Freights and Wholesale Prices, 1869–1936.
Index Numbers. Base Year, 1869 = 100.

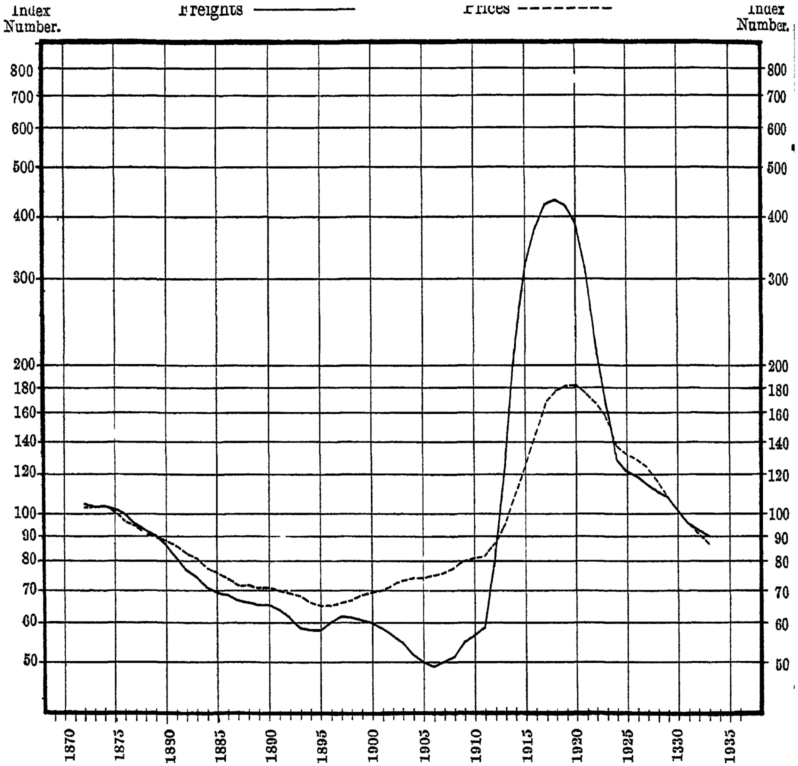


Apart from minor fluctuations during the latter part of this period, the peaks have occurred in 1873, 1881, 1888, 1900, 1907 and 1912. These may be compared with the peaks for trade fluctuations in general given by Pigou[5] 1872, 1882, 1890, 1900 and 1907. The agreement is close, and there is also, with some interesting exceptions, good agreement in the deviations from the general trends shown by the two series.

A remark that can perhaps be made on Industrial Cycles in general is certainly applicable to the shipping industry:

(1) It is certain that these cycles exist.
(2) Their periodicity—interval from peak to peak—is variable.
(3) Their amplitude is variable.
(4) The position of the peak or of the trough of a cycle in progress is not predictable.

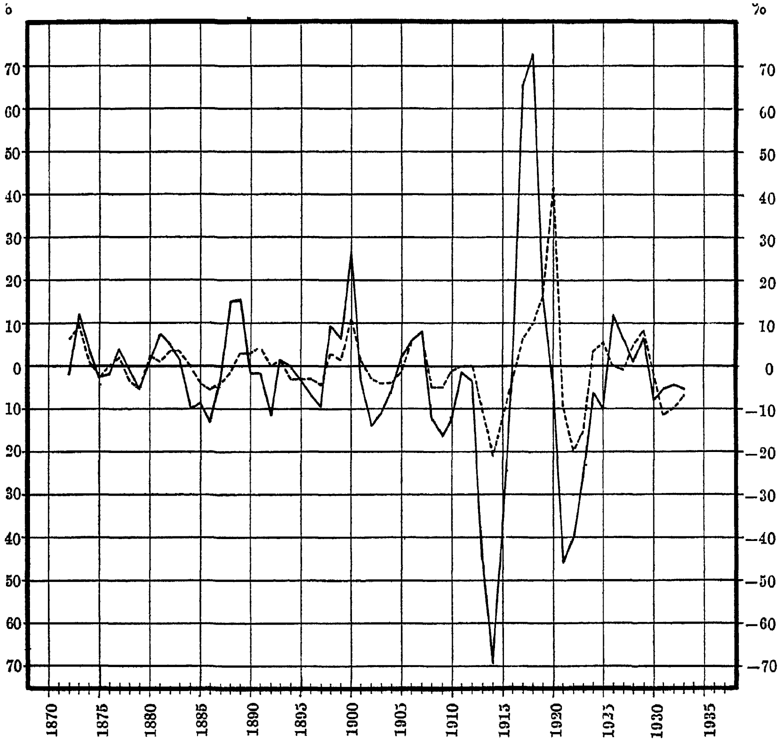
CHART 2.—Tramp Shipping Freights and Wholesale Prices, 1869–1936. General trends—seven year moving average. Base Year, 1869 = 100.



An *ad hoc* explanation can usually be found for each period of prosperity and for each phase of the cycle if sufficient knowledge is available of the conditions at the time. Thus the high shipping freights of 1873 and 1874 can be accounted for by the demand made on shipping tonnage by France and Germany for the restoration of their disturbed trade after the Franco-German War. The 1900 peak is connected with the demand for shipping caused by the South African War. It may, of course, be that secular causes are at work which bring such incidents as wars, fluctuations of harvests and fluctuations in the prosperity of shipping and other industries in their train. The fact remains that it is comparatively easy to find explanations for the various stages of a trade cycle that is past, and that it is impossible to predict correctly the occurrence of the successive phases of a cycle which is in progress, and still more so in the case of a cycle that has not yet commenced.

CHART 3.—Fluctuations of Tramp Freights and Wholesale Prices. Deviations from general trend, per cent. of trend values, 1872–1933.

Freights ———— Prices --------



Section 4 (*b*). *Chamber of Shipping Index Number.* 1920 *to* 1937.

I started a monthly index number of tramp shipping freights in October 1921. A brief description of the construction of the index number will be found in the *Statist* for October 29, 1921, Volume 98, pp. 644–646. The year 1920 was taken as base; geometrical averages were employed. Twenty-seven routes, of which nine were between United Kingdom ports and European ports and the remaining eighteen were routes to or from ports outside Europe, were used.

There was no direct weighting, but a certain amount of indirect weighting was introduced by employing more quotations on the more important routes. In the initial calculations the index was calculated for each of the twenty-one months from January 1920 to September 1921, and was re-calculated for each of the first five months of 1921 by weighting the components outside European waters, using as weights the average numbers of vessels recorded during those months as trading between Europe and the various areas outside Europe. The result was that, taking the average for the year 1920 as base, the values of the unweighted index number were 46, 38, 37, 39 and 40 for the months January to May 1921 inclusive, and the values of the weighted index were 43, 37, 36, 40 and 42. I considered the change produced to be slight, and decided to be content with the unweighted index. An alteration was made in January 1922, when the number of routes was reduced to 21, as, owing to my inexperience, routes had been introduced on which quotations were rarely available, and owing to my ignorance of both geography and shipping, Bahia Blanca had been treated as a port in Brazil. This index has been in continuous use as the Chamber of Shipping Index of Tramp Freights since October 1921. It has been the subject of much criticism, but no one has criticized it so severely as I am inclined to do myself. The best that can be said for it is what Dr. Johnson said of the dog walking precariously on his hind legs, "The wonder is not that he does it badly, but that he does it at all."

The yearly averages of the Chamber of Shipping Index Number for the seventeen years 1920 to 1936 can be compared with those in Table VIII by equating the two indices for a common year. For the year 1920 the latter index (based on 1869 = 100) was 374. If the Chamber of Shipping Index based on 1920 is also called 374 for that year, we get the following comparison :—

TABLE J

Year	Sixty-eight Years Freight Index	Chamber of Shipping Index	Year	Sixty-eight Years Freight Index	Chamber of Shipping Index
1920	374	374	1929	115	93
1921	166	141	1930	93	71
1922	130	111	1931	90	74
1923	123	106	1932	88	70
1924	121	111	1933	85	68
1925	110	95	1934	85	71
1926	133	105	1935	88	71
1927	122	104	1936	103	84
1928	112	96			

The discrepancies are at first sight very great, but a little consideration will show that they are in the main due to the unreliability of the sixty-eight-year freight index in years such as 1920, when freights fell catastrophically, since in such years the assumption that half the sum of the highest and lowest freight rates on any particular route during the year could be used to represent the mean freight rate on that route for the year was unlikely to be correct. If the two indices are equated for the year 1929, the comparison for the last eight years is as follows :—

TABLE K

Year	Sixty-eight Years Freight Index	Chamber of Shipping Index	Year	Sixty-eight Years Freight Index	Chamber of Shipping Index
1929	115	115	1933	85	84
1930	93	88	1934	85	87
1931	90	92	1935	88	88
1932	88	87	1936	103	104

The two little dogs may not be sitting up very well, but they are keeping good time to the same tune.

Section 5. *Employment of Tramp Shipping*

As a result of the passing of the British Shipping (Assistance) Act 1935 (25 Geo. 5, in February 1935) there was provided for the first time complete and exact information with regard to the tramp voyages, the cargoes carried and freights earned in the foreign trade by vessels registered at a port in the United Kingdom. By the terms of the Act every owner of an eligible ship, which during any quarter of the subsidy year has completed an eligible voyage, must, if he wishes to claim subsidy in respect of that voyage, make application to the Tramp Shipping Subsidy Committee appointed under the Act, within a period of 21 days after the completion of the voyage, and the application must include such particulars as the Committee may direct. (Compare Memorandum on Financial Resolution, November 1934, Cmd. 4754, Section 2, Part 1, Paragraphs 5 and 6.)

By the courtesy of the Subsidy Committee I was supplied with the following particulars of the 12,491 eligible voyages in respect of which subsidy applications were made to the Committee for the year 1935: Index Number of Application, Name of Vessel, Name of Owner or Manager, Gross Tonnage, Number of eligible days claimed, Commencing and final dates of the period, Tonnage of Cargo, Nature of Cargo, Loading Port and Discharging Port. The information was transferred to cards, of which the following is a specimen.

Index Number of Application	58,626
Name of Vessel	*Sarah Ann*
Name of Owner or Manager	Merchant Venturers, Ltd.
Gross Tonnage	6,317
Number of eligible days claimed ...	39

Commencing and final dates of the period	July 3, August 10
Weight of Cargo	8,918 tons
Nature of Cargo	Phosphate
Freight	7*s*. 3*d*. per ton
Port of Loading	Casablanca
Port of Discharge	Cape Town.

The 12,491 cards were sorted according to the direction of the voyage and the nature of the cargo carried. It was soon found that vessels of under 3,000 gross tons were almost entirely employed in carrying cargoes, chiefly outward coal cargoes, between the United Kingdom and nearer European destinations, and that a misleading picture of the world distribution of the work of what may be described as deep-sea tramp shipping would be obtained if no distinction were drawn between the work of these smaller vessels and those of larger type. A primary division was accordingly made in which the voyages of vessels of under 3,000 gross tons were shown separately. It was thought desirable to employ the material so as to obtain precise information as to the amount of carrying and the freight earned by United Kingdom vessels when employed on tramp voyages in carrying—

(*a*) between the United Kingdom and Empire countries;
(*b*) between the United Kingdom and foreign countries;
(*c*) between Empire countries and foreign countries; and
(*d*) between foreign countries.

In what follows, ports in the United Kingdom are denoted by U; Empire ports outside the United Kingdom are denoted by E, and foreign ports are denoted by F. Voyages from United Kingdom ports to foreign ports and from United Kingdom ports to Empire ports are denoted by UF and UE respectively, while the homeward voyages are denoted by FU and EU. Similarly EF denotes a voyage from an Empire port outside the United Kingdom to a foreign port and FE denotes a voyage from a foreign port to an Empire port outside the United Kingdom. Finally, FF denotes a voyage which begins at one foreign port and terminates at another foreign port. The first broad result of the analysis is given in Table L on page 81. Voyages which commenced towards the end of 1934 and were terminated on or after January 1, 1935, have been included as 1935 voyages. On the other hand, voyages which commenced towards the end of 1935 but were not completed until some time in 1936 have been omitted from the calculations. These last numbered 604. There were also included in the 12,491 voyages, 121 ballast voyages which contribute nothing to the cargoes or freights analysed in the table. These ballast voyages were included in the subsidy applications for

TABLE L

U.K. Tramp Voyages in 1935[*]

	EE	EF	EU	FE	FF	FU	UE	UF not coal	UF coal	UF Total	Total
(1) Vessels of 3,000 gross tons and over:											
Number of voyages	634	317	460	164	1,195	809	322	21	890	911	4,812
Cargo tons	4,823,792	2,310,475	3,517,833	1,024,745	8,404,849	5,430,363	2,045,554	114,566	5,789,721	5,904,287	33,491,898
Freight, £'s	2,313,194	1,928,783	3,205,110	843,308	6,075,511	3,738,767	772,754	67,405	2,337,014	2,404,419	21,312,146
Per cent. of total freight	9·55	7·86	13·06	3 44	24·76	15·24	3·15	0·27	9 53	9·80	86·87
(2) Vessels of under 3,000 g.t.											
Number of voyages	—	—	4	68	333	2,076	31	363	4,079	4,442	6,954
Cargo tons	—	—	5,916	75,200	1,004,627	2,985,064	98,313	329,332	7,291,732	7,621,064	11,790,184
Freight, £'s	—	—	8,874	19,810	268,131	1,083,944	33,135	74,118	1,733,035	1,807,453	3,221,647
Per cent. of total freight	—	—	0 04	0·08	1·09	4·12	0·14	0·30	7 06	7·36	13·13
(3) All vessels:											
Number of voyages	634	317	464	232	1,528	2,885	353	384	4,969	5,353	11,766
Cargo tons	4,823,792	2,310,475	3,533,749	1,099,945	9,409,476	8,415,427	2,143,867	443,898	13,081,453	13,525,351	45,282,082
Freight, £'s	2,343,494	1,928,783	3,213,984	863,118	6,343,942	4,822,711	805,889	141,823	4,070,049	4,211,872	24,533,793
Per cent. of total freight	9·55	7·86	13·10	3·52	25·86	19·66	3·28	0·58	16 59	17 17	100 00
Incomplete voyages omitted above	22	24	97	18	134	137	17	3	152	155	604
Ballast Voyages: Vessels of 3,000 g.t. and over	—	—	—	—	—	—	—	—	—	—	114
Ballast Voyages: Vessels of under 3,000 g.t.	—	—	—	—	—	—	—	—	—	—	7
TOTAL	—	—	—	—	—	—	—	—	—	—	12,491

[*] Including to France 2,313 voyages, 3,176,398 tons cargo, £700,078 gross freight or 2·85% of total freight.

the year 1935 under the terms of Section 2, Part I, Para. 2 (*c*) of the Memorandum on the Financial Resolution, Cmd. 4754, which, dealing with duration of eligible voyages, provided that it might include time occupied in ballast voyages—

(*a*) to fetch cargo booked;
(*b*) to seek cargo in accordance with the normal custom of the tramp trade;
(*c*) to pay off crew after discharging cargo.

It will be seen from the table that in the year 1935 United Kingdom ships engaged in tramping completed 11,766 voyages, on which they carried 45·3 million tons of cargo and earned £24·5 million in gross freights. 6,954 of the voyages, or nearly 60 per cent., were by vessels of under 3,000 gross tons, but they carried only 11·8 million tons of cargo, of which 7·3 million tons was export coal to foreign countries, and earned only £3·2 million freight, to which export coal contributed £1·7 million. These smaller vessels also carried 3 million tons of cargo homewards from foreign countries, on which they earned £1·1 million. In other words, apart from the export coal traffic to European destinations and a small amount of homeward cargo, tramp vessels of under 3,000 gross tons play only a small part in overseas trade. The distribution of cargoes and freight, according to areas, shows that for all vessels 9·4 million tons of cargo out of 45·3 million tons were carried in trades in which both terminal ports are in foreign countries, and such trade accounted for 25·86 per cent. of the total earnings. The smaller vessels earned very little in this trade. If we combine the cargo carried in EE, EF, FE and FF, *i.e.* in the trades in which neither terminal is in the United Kingdom, we find that 17·6 million tons, or nearly 40 per cent., of the total cargo was carried in such trades, and that such carrying accounted for £11·5 million, or 47 per cent. of the gross freight earned. The proportion of FF trade is higher for tramps than for foreign-going shipping as a whole.

In the following table I have carried out a similar analysis, also on broad lines, of the different types of cargo carried on tramp voyages.

A tramp ship will carry any bulk cargoes, and I was surprised to find that nineteen or twenty headings would account for 94 per cent. of the voyages, 95 per cent. of the weight of cargo and 92 per cent. of the gross freight earned, although it must be confessed that some of the headings, such as line 8, fertilizers, and line 20, West African produce (the latter is so described in the Subsidy applications), cover several items; so of course does line 2, grain, in which it was not possible to distinguish separately wheat, maize, oats and so forth, as

TABLE M

Tramp Cargoes Carried by U.K. Ships in 1935

	In Ships of 3000 g.t. and Over			In Ships of under 3000 g.t.			In all Ships			Per Cent.		
	No.	Tons	Freight, £	No.	Tons	Freight, £	No.	Tons	Freight, £	No.	Tons	Freight, £
1. Coal and Coke ...	1,873	12,590,477	4,650,820	4,299	8,013,955	1,884.948	6.172	20,604,432	6,535,768	52·46	45·50	26·64
2. Grain (including Soya Beans and Rice)	1,200	8,977,951	7,421,546	416	301,056	86,050	1,616	9,279,007	7,507,596	13·73	20·49	30·60
3. Grain and Timber ...	105	892,500	814,406	—	—	—	105	892,500	814,406	0·89	2·19	3·32
4. Timber	196	1,346,533	1,764,355	377	1,120,271	556,168	573	2,466,804	2,320,523	4·87	5·45	9·46
5. Timber and other cargoes	19	110,484	57,644	—	—	—	19	110,484	57,644	0·16	0·24	0·24
6. Ore	398	2,829,055	1,421,940	323	839,482	225,910	721	3,668,537	1,647,850	6·13	8·10	6·72
7. Sulphur and Zinc concentrates ...	7	44,100	38,588	—	—	—	7	44,100	38,588	0·06	0·10	0·16
8. Fertilizers	207	1,533,419	1,091,483	227	287.290	90,778	434	1,820,709	1,182,261	3·69	4·02	4·82
9. Sugar	204	1,424.969	1,129,735	18	9,198	1,136	222	1,434,167	1,130,871	1·89	3·17	4·61
10. Iron and Steel and Scrap	99	748.272	532,167	262	212,666	53,470	361	960,938	585,637	3·07	2·12	2·39
11. Salt	86	695,740	347,870	—	—	—	86	695,740	347,870	0·73	1·54	1·42
12. Paper	30	140,455	87,061	5	900	225	35	141,355	87,286	0·30	0·31	0·35
13. Strawboards ...	—	—	—	40	32,000	8,800	40	32,000	8,800	0·34	0·07	0 04
14. Esparto	7	16.555	11,175	87	148,248	109,333	94	164,803	120,508	0·80	0·36	0·49
15. Bauxite	17	88,672	28,818	18	64,692	22,642	35	153,364	51,460	0·30	0·34	0·21
16. Sand, Cement, etc. ...	—	—	—	299	218,270	35,469	299	218,270	35,469	2·54	0·48	0·14
17. China Clay	10	48,390	32,663	55	29,700	10,395	65	78,090	43,058	0·55	0·17	0·18
18. Pitch and Asphalt ...	—	—	—	144	169.200	33,840	144	169,200	33,840	1·22	0·37	0·14
19. Cork	—	—	—	16	12,768	10,853	16	12,768	10,853	0·14	0·03	0·04
20. West African Produce	40	245,120	208,352	—	—	—	40	245,120	208,352	0·34	0·54	0·85
21. General and Mixed...	314	1,759,206	1,673,523	368	330.488	91,630	682	2,089,694	1,765,153	5·80	4·61	7·19
Total ...	4,812	33.491,898	21,312,146	6,954	11,790,184	3,221,647	11,766	45,282,082	24,533,793	100	100	100

some of the applications used the general word. The mixed cargoes of grain and timber in line 3 refer entirely to cargoes from British Columbia to the United Kingdom and consist of about two-thirds grain and one-third timber. The first point of interest in the table is that when the smaller vessels of under 3,000 gross tons are included, coal and coke account for over 52·5 per cent. of the voyages, 45·5 per cent. of the weight of the cargo, but only 26·6 per cent. of the freight. Grain by itself accounts for 13·7 per cent. of the voyages, 20·5 per cent. of the weight of the cargo and 30·6 per cent. of the freight. For the larger ships, coal and coke account for less than 22 per cent. of the freight, while grain accounts for nearly 35 per cent. The rather vague term "General and Mixed" includes a miscellaneous group such as cauliflowers, strawberries, raisins and apples from the Continent, oranges, wool and ground-nut cakes for the smaller vessels, and for the larger vessels such oddments as gunnies, tobacco, cotton and cottonseed, and even furniture.

My education in shipping matters commenced with the lesson that the economics of British shipping, or at any rate of British tramp shipping, rested on the carriage of coal outwards from the United Kingdom and the carriage of grain and raw materials homewards by the same vessels. This may have been a correct picture in the years before the War in which British shipping supremacy was built up, but a closer analysis of the coal cargoes in line 1 of the table shows that this is far from correct to-day. Our tramp vessels in 1935 carried 20·6 million tons of coal, but of this coal only 12·6 million tons originated in the United Kingdom, and less than 8 million tons of coal from the United Kingdom was carried by the vessels of 3,000 gross tons and over, which are responsible for the bulk of our imports of grain and raw materials. For the larger vessels the balance of cargoes was somewhat as follows:—

		Million Tons
Coal Cargoes from the United Kingdom		7·6
Other Cargoes—from the United Kingdom		0·3
—to the United Kingdom		9·0
Cargoes with origin and destination outside the United Kingdom	Coal	5·0
	Other Cargoes	11·6
		33·5

The Subsidy Committee's data for 1935 can be combined with the information now available in the Annual Statement of Trade to show the share taken by United Kingdom ships and by foreign ships in Coal and Coke exports of the United Kingdom in 1935. The details are given in Table N (p. 85).

The most important countries to which our coal exports went in

TABLE N

United Kingdom Coal and Coke Exports in 1935—*Omitting Channel Islands and Irish Free State*

(Tons 000)

To	Exports			Carried in U.K. Ships			Carried by Foreign Ships	%
	Coal	Coke	Total	of 3,000 g.t. and Over	of under 3,000 g.t.	Total		
Malta, Palestine, Aden	208	—	208	94	11	105	103	49·5
Canada and Newfoundland	1,845	6	1,851	1,287	33	1,320	531	28·7
Gibraltar	548	—	548	377	55	432	116	21·1
Other British Countries	333	67	400	94	—	94	306	76·5
Total to British Countries ...	2,934	73	3,007	1,851	98	1,919	1,058	35·2
South America... ...	2,878	297	3,175	2,111	—	2,111	1,064	33·5
Canary Islands ...	228	—	228	90	—	90	138	60·5
U.S.A.	187	71	258	176	—	176	82	31·7
Egypt	1,757	—	1,757	1,165	—	1,165	592	33·6
France	7,130	119	7,249	130	3,176	3,306	3,943	54·4
Italy	3,189	94	3,283	1,235	124	1,359	1,924	58·6
Tunis, Algeria, Morocco and N. Africa ...	1,397	129	1,526	691	271	962	564	37·0
Spain and Portugal ...	2,282	110	2,392	84	705	789	1,603	67·0
Greece	186	8	194	—	29	29	165	85·1
Germany	2,885	183	3,068	—	790	790	2,278	74·3
Holland...	1,503	46	1,549	—	617	617	932	60·2
Sweden	2,527	207	2,734	—	140	140	2,591	94·9
Norway	1,311	422	1,733	—	100	100	1,633	94·2
Latvia	457	28	485	—	75	75	410	84·5
Iceland	138	—	138	—	59	59	79	57·2
Lithuania	196	—	196	—	28	28	168	85·7
Denmark	3,175	987	4,162	—	695	695	3,467	83·3
Belgium	631	—	631	—	336	336	295	46·8
Finland	744	149	893	—	108	108	785	87·9
Other Foreign Countries	645	227	872	109	39	148	724	83·0
Total to Foreign Countries ...	33,446	3,077	36,523	5,790	7,292	13,082	23,440	64·2
Total to all Countries	36,380	3,150	39,530	7,641	7,390	15,031	24,499	62·0

1935 were: France 7·3 million tons; Denmark 4·2 million tons; Italy 3·3 million tons; Germany 3·1 million tons; South America 3·2 million tons; Sweden 2·7 million tons; Egypt 1·8 million tons and Norway 1·7 million tons. Only in the case of exports to South America and Egypt did British ships have more than half the carrying. It is very disconcerting to find for the Scandinavian countries that Sweden and Norway carry over 94 per cent. of their coal purchases from this country in foreign vessels, and Denmark, from whom we purchase so much more than she does from us, imported more than 80 per cent. of her coal in foreign vessels in 1935. The details of the voyages on which the various cargoes in Table M were carried are shown in Table IX in the Appendix.

An important new Board of Trade return, entitled *Oversea Trade of the United Kingdom, Nationality of Carrying Vessels*, was published in September this year, and shows for the year 1936 the proportions by value of the trade of the U.K. with British and foreign countries carried in vessels of various nationalities. Separate particulars are given for Classes I, II, III of the Trade Returns, and actual weights are given for U.K. exports of coal and for important groups of imports. The tables in this return deserve careful study. Table 5, page 18, Exports of Coal, is of particular interest in the present connection. The table indicates that the proportion of coal exports carried by British ships in 1936 was rather higher than the proportion of coal and coke so carried in 1935, but the small part played by British ships in coal exports to Norway, Sweden and Denmark is just as noticeable in the Board of Trade's return for 1936 as in the Subsidy Returns for 1935.

Section 6. *Weighted Index Number of Tramp Shipping Freights*

There is no distinction of principle between an index number of prices and an index number of freights. In the case of the former, the data consist of quantities of the various commodities and their prices in the base year and quantities and prices in the given year. Freight is the price for service. In constructing an index number of freights, our data should be the quantity of cargo carried on particular routes, and the average freights on those routes in the base year, and the corresponding quantities and freights in the given year.

The arguments used by Irving Fisher [6] when considering index numbers of prices apply equally to index numbers of shipping freights.

His ideal formula, 353, would indeed be ideal if the data were available. His index number is the geometrical mean of two fractions. In the first, the aggregate of quantities in the base year multiplied by prices in the given year is compared with the aggregate of quantities in the base year multiplied by prices in the base year. In the second, quantities in the given year are substituted for quantities in the base year. Prices, or a good sample of them, can generally be obtained from trade papers, and various devices can be used for quantities or reasonable estimates of them. For many of the commodities which enter into an index number of wholesale prices, for example, we can use the official import and export statistics. In the case of Freights, the price element—rates of freight—is well catered for. Daily and weekly newspapers, and particularly shipping journals, contain records of fixtures of tramp vessels chartered to carry specified cargoes on the specified voyages, the voyage to commence almost at once (spot fixtures), or at some approximately named date ahead. In particular, the *Daily Freight*

Register, known to shipowners familiarly as the Green List, because it is printed on paper reminiscent in colour of the now defunct *Westminster Gazette* (familiar to some of us in our younger days as "The Sea Green Incorruptible"), gives daily a list of fixtures arranged on the previous or an earlier day, which have come to the notice of the *Journal*. The lists of fixtures given are very full, although necessarily incomplete, as neither the charterer nor the shipowner is under any obligation to publish.

The *Daily Freight Register* was commenced in 1893, and for a number of years it has published, by way of special supplement, annual reviews which are invaluable to the student of shipping freights. A special supplement for 1936 gives the highest, lowest and average freight rate on 356 routes, as follows :—

	Routes
Coal Freights Outwards from the United Kingdom	170
" " " Continent	25
Other Coal Freights	12
Mineral Freights from Mediterranean and Bay Ports	26
Other Mineral Freight Rates	9
Freights for Grain, Seeds, Rice, Sugar, etc., from North America, South America, the Pacific, India, the Far East, South and North Africa and the Black Sea	48
Timber Freights	51
Phosphate Freights	9
Iron and Steel and Scrap Freights	6
Total	356

In addition, time charter rates were given on eleven routes.

The D.F.R. summary is not likely to miss a route on which a fair number of fixtures were made during the year, but the annual average is based on the fixtures recorded in the Register during the year, and therefore takes no account of the unreported fixtures. For the year 1935 the differences between the D.F.R. averages and the averages that can be deduced from the 12,400 applications made to the Subsidy Committee are two-fold. As regards fixtures of British vessels, the D.F.R. averages are based on incomplete data. Secondly, the D.F.R. averages are based on data which include some fixtures of foreign vessels.

There is an important distinction between tramp freight rates as recorded from time to time in shipping papers and similar records of wholesale prices in other trade papers. The freight rates obtained from the analysis of subsidy applications are the freights at which the cargo was actually carried on the voyage which commenced and terminated on the dates stated in the application. The freight rates recorded on any particular day in the *Daily Freight Register* refer to fixtures made on the previous day, or at any rate fixtures which come to the notice of the editor of the paper before the day of publication. Some of these, perhaps a minority, are spot fixtures—that is to say, a vessel may, for example, be already at Buenos Ayres, and the owners of the vessel have arranged with a charterer, probably on the Baltic Exchange in London, that the vessel shall undertake a specified voyage from the River Plate almost at once, loading probably commencing within the next few days. In the majority of cases, however, the fixtures are ahead; a River Plate/Home fixture reported on April 28, 1937, for example, may refer to a vessel which is on her way to the United Kingdom, is already chartered to take a cargo of Coal from Cardiff to Brazil, and is expected to be available for loading cargo from the River Plate in the middle of June. The contract is a fixed contract for, say, lay days to commence on June 15, 1937, with a cancelling date of, say, June 30, 1937, which means that if the vessel arrives in the River Plate on June 13 or 14, 1937, the owners inform the charterers that the vessel is ready and loading time must commence on June 15 as arranged. If the vessel fails to arrive in the River Plate by June 30, the charterers may exercise their option of cancelling the contract.

There would appear to be no real analogy between this and the sale of futures in the cotton or grain markets. The freight rates that may be agreed on a date in April on the Baltic for spot boats or for boats for April/May or late May or May/June all reflect that day's opinion held by charterers and shipowners, and they are all correctly lumped together by a shipping paper which later on speaks of average freights during April. The price for cotton futures at Liverpool differs from the spot price because it reflects dealers' estimates of what the price of cotton is likely to be next month or the month after. It refers to a sale and purchase of a quantity of cotton of a particular grade or quality, but has no reference to particular individual bales of cotton. The fixture of a ship ahead usually refers to a definite named ship.

It follows that the average of freights on a particular route for voyages in, say, May 1935, as shown in the Subsidy applications, is not the average of freight for May in the ordinary sense of the phrase as used by charterers and owners on the Baltic. The freight rates in question may have been agreed in May if the boat was a spot boat, but were more likely agreed in April or March, or even before that. Freight rates, on the other hand, as recorded in the shipping papers during May do properly form the basis for an average for that month.

It seems legitimate to use the Subsidy applications for 1935 in order to obtain average freight rates for the year as a whole, but not the average freight rates appropriate to any particular month of that year.

As regards quantities, apart from the subsidy data, there is no information at all. The Board of Trade Memorandum of 1904 used weights roughly in the proportion of the tonnage of British vessels entered with cargo from four areas and cleared with cargo to five areas.

Mr. Macrosty in 1926 used a combination of entrances and clearances with cargo and of weights of certain import and export cargoes. Those familiar with shipping statistics are aware that there is no close relation between the net tonnage of vessels entered or cleared with cargoes and the weight of the cargoes carried by these vessels. So long as the year 1935 is the only year for which the weight of the cargoes carried on the different routes has been precisely determined, one essential in Irving Fisher's ideal formula is missing. If 1935 is taken as the base year and 1929 or 1936 as the given year, what correspond to Fisher's prices p_0 and p_1 are known, at least approximately, but of Fisher's quantities q_0 for the base year is known, but q_1 for the given year is not. We must be satisfied with half of Fisher's formula

$$\frac{\Sigma q_0 p_1}{\Sigma q_0 p_0}$$

namely, the aggregative index in which the base year q's are used in the numerator and denominator.

If the D.F.R. annual averages are to be employed for the p's in the various years which are to be compared with the year 1935, it becomes important to examine the reliability of these averages. For the year 1935 average freights on 92 routes in the Subsidy Committee's data were also available in the Annual Summary of the D.F.R. In two cases the averages agreed. In 46 cases the D.F.R. average was higher and in 44 cases lower than the corresponding average in the Subsidy data.

If we express the D.F.R. average for each route as a percentage of the average given by the Subsidy data and arrange the differences per cent. in a frequency table, we find a mean difference of 0·53 per cent., and a standard deviation of 9·59 per cent., giving for 92 routes 1·00 per cent. as the standard error of the mean, so that the difference between the D.F.R. averages and the subsidy data averages is 0·53 per cent. ± 1·00 per cent. In other words, if we combine the averages for routes in order to obtain a single average for all routes to be used as an index number according to some reasonable system of weighting, there will be no significant difference in our results if we use the D.F.R. annual averages instead of the correct averages, although on any particular route or in any group based on a small number of routes the difference may be serious.

After weighing up various possible alternatives, I decided to use as the separate group components in the new index number allied groups of cargo rather than allied groups of routes, using for this purpose Table M on page 83. For each component in each group, I calculated at first (using T, F as representing tons and freight instead of Fisher's q, p) $T_{35}\ F_{35}$, the gross freight earned by carrying the cargo known to have been carried by British tramp vessels in 1935 at the freights known to have been obtained, the aggregate for this column being £24,533,793 as shown in the column for Freight on all ships in Table M.

The next step was to calculate $T_{35}\ F'_{29}$, $T_{35}\ F'_{35}$ and $T_{35}\ F'_{36}$, the accents in the freights for 1929, 1935 and 1936 denoting that the average freights were those given in the D.F.R. in each case.

In calculating the group index number for outward coal from the United Kingdom in vessels of 3,000 gross tons and over, for example, I found that the aggregate for $T_{35}\ F_{35}$ was £4,650,820 for the 29 routes included in the group, but that the corresponding average rate in the D.F.R. was only available on 16 of these routes in 1929. The total $T_{35}\ F_{35}$ on these 16 routes was £3,750,112, and the corresponding $T_{35}\ F'_{29}$ was £5,101,612, or 36·039 per cent. higher. I therefore increased the £4,650,820 for the whole 29 routes in $T_{35}\ F_{35}$ by this percentage and obtained £6,326,929 as the estimated total contribution of this group to $T_{35}\ F'_{29}$. The final results were

$$\begin{aligned} T_{35}\ F_{35} &= \text{£}24{,}533{,}793 \\ T_{35}\ F'_{29} &= \text{£}32{,}757{,}554, \text{ and} \\ T_{35}\ F'_{36} &= \text{£}27{,}621{,}273. \end{aligned}$$

On this basis the index number for 1929, taking 1935 as 100, is 133·520, and the index number for 1936 is 112·585. The index number is not strictly reversible, since, as explained above, only half of Fisher's ideal formula has been used. With this *caveat* we may change to base 1929 = 100 and find 74·895 as the index number for 1935 and 84·320 as the index number for 1936.

The final determination of group weights for the new monthly index number is as follows :—

Group 1 (*a*). *Coal, in ships of under* 3,000 *gross tons.*

Twenty-five routes from South Wales to France, Algiers, Gibraltar, Portugal, Greece, Holland and Canada, and 11 routes from Scotland and the North-east Coast to France, Denmark, Finland, Germany and Italy.

The total weight for the group was taken to be 2,116, corresponding to £1,884,948 in line 1 of Table M, the total freight earned by vessels under 3,000 gross tons in respect of Coal and Coke cargoes, increased by £231,000 to take into account the cargoes, other than Coal, carried in ships of under 3,000 gross tons in lines 12 to 19 of Table M, on the not unreasonable assumption that these cargoes, some outwards and some homewards, are carried by vessels of the same type and are alternatives to Coal cargoes to the nearer European destinations.

Group 1 (*b*). *Coal, in ships of* 3,000 *gross tons and over.*

Eleven routes from the United Kingdom, mainly South Wales, 4 routes from Continental ports to the Mediterranean, Canada, the United States and South America, and 1 route each Durban to Colombo, Calcutta to Bombay, French Indo-China to France.

The total weight for this group was taken to be 4,651, to agree with the freight for coal and coke in bigger ships in line 1 of Table M.

Group 2. *Grain Cargoes.*

Seventeen routes were used, comprising the following: Wheat, Maize, etc. to United Kingdom and Continent: 3 from the United States and Canada, 4 from South America, 3 from Australia, 1 from South Africa, and 2 from the Black Sea. Rice from Burmah and Saigon and Beans from Dalny: 1 Grain freight from the Black Sea to Vladivostock.

The total weight given to this group was 12,406, corresponding in Table M to line 2, Grain £7,507,596; line 3, Timber and Grain £814,406; line 20, West African Produce £208,352, line 21, General and Mixed Cargoes £1,765,153; line 5, Timber and other Cargoes £57,644; part, £1,544,000, of the Timber in line 4 corresponding to Timber cargoes not from Russia not to the United Kingdom, consisting mainly of Lumber from the Pacific ports of North America and usually alternating with Grain cargoes from those ports to the East. Another item of 508 was added to the weight corresponding to the cargoes in lines 11 to 19 carried by the bigger vessels. (Total freight £507,587.) It will be recalled that the cargoes mentioned in these lines carried by ships of under 3,000 gross tons were assimilated to coal carried by the smaller ships in Group 1(*a*).

Group 3. *Timber.*

The routes used are: White Sea Ports to Holland; Finland (Lower Zone) to East Coast of United Kingdom; Leningrad to Holland; Leningrad to United Kingdom/Continent.

Total weight 777, corresponding to £556,168 in the smaller vessels in line 4 and £221,000 the part of line 4, Timber from Russia in larger vessels not assimilated with Grain in Group 2.

Group 4. *Ore.*

Twelve routes, including 7 from Spain and Africa to the U.K. and Continent, 1 from Spain to the United States, 1 from the Black Sea to the United States, and 3 from India to U.K. and Continent.

The total weight given to this group was 1,686, corresponding to the £1,647,850 in line 6, with which for convenience line 7, Sulphur and Zinc Concentrates (£38,588), has been assimilated.

Group 5. *Fertilizers.*

There are 2 routes in this group: Nitrate, Chile to the Continent, and Phosphate from Sfax or Susa to the United Kingdom.

The total weight given to this group, 1,182, corresponds to £1,182,261 in line 8.

Group 6. *Sugar.*

Five routes are in this group: 2 from Cuba to U.K./Continent and 1 each from Santa Domingo, Mauritius and Queensland.

The total weight for the group, 1,131, corresponds to £1,130,871 in line 9.

Group 7. *Iron and Steel and Scrap.*

Three routes in this group are all from the United States. 1 to Japan, 1 to Italy, and 1 to the United Kingdom.

The total weight used for this group is 585, corresponding to £585,637 in line 10.

Monthly Index Numbers.

In the monthly index only such of the 97 routes for which quotations are conveniently available are used, relevant weights are given to them based on the 1935 data, and the group index is then given the weight calculated, as explained above. In practice it makes very little difference which particular 10 or 12 of the 36 coal routes are used in a particular month, as the correlation between freights from Cardiff to Bordeaux, Brest, Dieppe or Havre, and so forth is very high. The same principle as regards missing quotations is applied when the whole group is missing. In the first monthly index number, in Table O that for January 1937—the timber group, which consists of routes closed by ice in the winter, was not available. Timber was given a weight 777 out of a total of 24,534. In calculating the index number for January, the timber group was omitted and the total weight was reduced by 777 to 23,757. The problem of dropping out of quotations is a serious one. The manner in which it should be dealt with is a matter of opinion.

A complete list of the routes used as material for the new monthly index number, with the subsidy data weights and the *Daily Freight Register* average freights for 1935, is shown in Table X of the Appendix.

Group index numbers, and the total index number for the first nine months of 1937 are given below :—

TABLE O

Weighted Index Number of Tramp Shipping Freights. January to September 1937 (1935 = 100)

Group	Weight	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1(*a*). Coal, in vessels of under 3,000 gross tons ...	2,116	125·1	132·3	132·8	137·3	147·8	170·3	160·2	144·4	156·4
1(*b*). Coal, in vessels of 3,000 gross tons and over	4,651	119·5	120·1	117·4	138·6	156·4	168·1	159·6	155·7	162·1
2. Grain, etc. ...	12,406	189·8	176·0	174·4	193·7	203·8	194·9	198·1	214·0	220·5
3. Timber ...	777	—	126·8	147·1	141·2	142·1	182·4	181·3	194·5	190·1
4. Ore	1,686	187·4	181·6	185·1	201·8	180·0	177·1	186·1	204·2	231·6
5. Fertilisers ...	1,182	158·5	137·0	135·5	143·6	155·5	177·0	—	172·3	212·3
6. Sugar	1,131	168·7	152·2	170·8	203·2	200·1	203·3	189·2	215·4	192·4
7. Iron and Steel and Scrap ...	585	197·6	194·6	218·9	259·4	267·7	255·8	192·8	191·7	208·1
	24,534	167·7	157·9	158·9	176·8	185·4	187·1	185·0	193·3	201·7

Converting these approximately to base 1929 = 100, by using the factor 0·74895, we get the following series in which, for convenience, the annual index numbers for 1935 and 1936 have been added.

TABLE P

Date	New Weighted Index Number	Chamber of Shipping Index Number
Average for Year		
1929	100	100
1935	74·9	76·3
1936	84·3	90·8
January 1937	125·6	131·2
February 1937	118·3	130·9
March 1937	119·0	132·3
April 1937	132·4	138·4
May 1937	138·9	145·0
June 1937	140·1	136·5
July 1937	138·6	137·8
August 1937	144·8	153·6
September 1937	151·1	172·2
October 1937	142·3	160·1
November 1937	122·2	136·5

The main difference between the two index numbers is that in the old index number Grain is given much more weight relatively to Coal than in the new.

The great improvement in freights that set in at the end of 1936, and proceeded at an accelerated rate during 1937, showed first in the Grain freights, regulated by the Tramp Shipping Administrative Committee. Coal freights only benefited seriously by this upward movement in the later months of the year 1937.

Command Paper 4754, the Memorandum on the Financial Resolution presented to Parliament in November 1934 in connection with the British Shipping (Assistance) Act, 1935, provides in connection with the £2 million subsidy granted under the Act, in Section 2, Part I (14);

> " If in the opinion of the Board of Trade, at the end of the subsidy year, the average level of freight rates for the year (expressed as an Index Number representing a percentage) was less than the average for 1929 (represented by 100 per cent.) then the total sum payable by the Treasury for the year will be a sum not exceeding a quarter of a million pounds for every unit per cent., by which the average for the subsidy year is less than the average for 1929, subject to a maximum of £2 million."

I have so far given three values for the index numbers for 1935 and 1936 to base 1929 = 100.

Index Numbers to Base 1929 = 100

Year	Sixty-eight Year Freight Index	Chamber of Shipping Index	New Index Number
1935	77	76	75
1936	90	91	84
1937 (Jan.–Nov.)		143	134

According to the Command Paper, it is incumbent on the Board of Trade to draw the attention of the Treasury to the average value of the index number for 1935 and for 1936 if " in the opinion of the Board of Trade " the index number exceeds 92 per cent. of the index number for 1929. These figures do not suggest that any action by the Board of Trade is called for. On the other hand, the index numbers for the first eleven months of 1937 make it unlikely that on any reasonable estimate of the course of freights during 1937 the average can be considered to be less than 100 per cent. of the average for 1929, and no subsidy should therefore be payable in respect of that year.

I must express a deep debt of gratitude to my colleagues at the Chamber of Shipping from whom I have learnt anything that is of value in the interpretation of shipping statistics, and in particular to my assistant, Mrs. Bray, without whose indefatigable help the preparation of the tabular material, the charts and the computations would have been a task far beyond my strength.

I began this paper by a reference to a fifteenth-century tract on

English Shipping Policie. I wish I could legitimately conclude by the following quotation from the end of the tract.

> "Here endeth the true processe of the Libel of English policie, exhorting all England to keepe the sea environ; shewing what profit and salvation, with worship commeth thereof to the reigne of England."

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APPENDIX

TABLE I

Classification of United Kingdom Tonnage on June 30, 1914

TYPE OF TONNAGE.

Owned or Managed on June 30, 1914, and Usually Engaged in the		Tramp	Cargo Liner	Passenger Liner	Mixed Cargo and Passenger Liner	Tanker	Other	Total
COASTING TRADE ONLY.	Number of Vessels ...	208	105	28	108	3	—	452
	Net tons	68,162	31,788	7,219	51,880	837	—	162,916
	Gross tons	118,719	68,611	20,525	125,225	1,833	—	331,973
	d.w. tons...	172,179	63,576	--	101,663	1,967		312,385
HOME TRADE ONLY (ELBE AND BREST LIMITS).	Number of Vessels ...	47	71	1	53	—	—	175
	Net tons	23,109	39,155	3,129	35,615	—	—	101,308
	Gross tons	11,408	73,871	7,138	61,731	—	—	181,151
	d.w. tons...	58,893	95,183	3,360	14,875	—		202,611
PARTLY IN COASTING AND PARTLY IN HOME TRADE.	Number of Vessels ...	168	3	—	9	—	—	180
	Net tons	67,038	1,356	—	5,711	—	—	74,138
	Gross tons	125,553	2,611	—	11,633	—	—	139,797
	d.w. tons...	177,051	3,660	—	10,191	—	—	190,908
FOREIGN TRADE ONLY (EXCLUDING TRADE BETWEEN ELBE AND BREST LIMITS).	Number of Vessels ...	811	995	12	509	108	—	2,465
	Net tons	1,779,800	2,757,192	119,303	2,061,652	331,029	—	7,318,976
	Gross tons	2,833,500	4,339,178	746,830	3,358,981	519,981	—	11,798,776
	d.w. tons...	4,711,600	6,801,215	561,866	3,101,533	772,485	—	16,351,699
PARTLY IN HOME AND PARTLY IN FOREIGN TRADE.	Number of Vessels ...	85	10	—	1	4	—	130
	Net tons	99,773	81,131	—	1,261	14,782	—	196,917
	Gross tons	165,432	128,173	—	2,145	23,585	—	319,635
	d.w. tons...	243,354	211,578	—	1,960	36,340	—	493,232
TOTAL.	Number of Vessels ...	1,319	1,214	74	680	115	48	3,450
	Net tons	2,038,182	2,910,622	429,681	2,159,152	346,618	6,021	7,890,309
	Gross tons	3,284,612	4,613,077	774,793	3,559,718	515,402	14,239	12,791,871
	d.w. tons...	5,363,080	7,178,512	565,226	3,566,225	810,792	11,134	17,495,269

TABLE II

Classification of United Kingdom Tonnage on June 30, 1929

TYPE OF TONNAGE

Owned or Managed on June 30, 1929, and Usually Engaged in the		Tramp	Cargo Liner	Passenger Liner	Mixed Cargo and Passenger Liner	Tanker	Other	Total
COASTING TRADE ONLY.	Number of Vessels ...	197	110	21	56	19	—	403
	Net tons	65,505	38,853	10,178	35,193	4,983	—	154,712
	Gross tons	119,135	84,608	24,622	77,735	10,580	—	316,680
	d.w. tons...	170,344	104,102	—	59,052	10,593	—	344,091
HOME TRADE ONLY (ELBE AND BREST LIMITS).	Number of Vessels ...	27	116	3	22	—	—	168
	Net tons	3,920	65,406	4,186	14,998	—	—	88,510
	Gross tons	8,928	134,219	10,344	33,764	—	—	187,255
	d.w. tons...	10,504	179,861	1,560	18,374	—	—	210,299
PARTLY IN COASTING AND PARTLY IN HOME TRADE.	Number of Vessels ...	201	12	—	4	3	—	220
	Net tons	86,659	4,355	—	2,773	1,036	—	94,823
	Gross tons	168,560	9,743	—	6,322	2,100	—	186,725
	d.w. tons...	237,379	12,343	—	5,662	2,365	—	257,749
FOREIGN TRADE ONLY (EXCLUDING TRADE BETWEEN ELBE AND BREST LIMITS).	Number of Vessels ...	769	1,007	74	416	223	—	2,489
	Net tons	2,061,800	3,484,414	657,957	2,205,563	812,572	—	9,222,306
	Gross tons	3,338,400	5,611,926	1,183,665	3,650,724	1,329,887	—	15,114,602
	d.w. tons...	5,663,500	7,697,343	725,943	3,390,438	1,902,261	—	19,379,185
PARTLY IN HOME AND PARTLY IN FOREIGN TRADE.	Number of Vessels ...	139	55	—	—	89	—	283
	Net tons	147,553	112,798	—	—	310,493	—	570,844
	Gross tons	254,571	187,330	—	—	521,501	—	963,405
	d.w. tons...	397,353	302,249	—	—	765,682	—	1,465,284
TOTAL.	Number of Vessels ...	1,333	1,300	98	498	334	69	3,632
	Net tons	2,365,437	3,705,826	672,321	2,258,527	1,129,084	32,104	10,163,199
	Gross tons	3,889,597	6,027,826	1,218,631	3,768,545	1,864,068	50,365	16,819,032
	d.w. tons...	6,479,080	8,295,898	752,125	3,242,071	2,680,901	47,169	21,704,377
LAID UP TONNAGE INCLUDED IN THE ABOVE.	Number of Vessels ...	21	32	6	12	3	—	74
	Net tons	18,435	89,450	10,450	61,101	6,540	—	185,976
	Gross tons	30,806	148,778	19,663	99,776	9,941	—	308,964
	d.w. tons...	48,459	186,535	9,470	99,308	15,034	—	358,806

TABLE III

Classification of United Kingdom Tonnage on October 1, 1933

TYPE OF TONNAGE

Owned or Managed on October 1, 1933, and Usually Engaged in the		Tramp	Cargo Liner	Passenger Liner	Mixed Cargo and Passenger Liner	Tanker	Other	Total
COASTING TRADE ONLY.	Number of Vessels ...	228	112	30	44	20		434
	Net tons	84,767	42,714	11,102	32,139	5,082	—	175,801
	Gross tons	156,503	94,214	27,048	71,313	10,781	—	359,889
	d.w. tons...	223,337	114,626	—	14,920	11,101	—	393,987
HOME TRADE ONLY (ELBE AND BREST LIMITS).	Number of Vessels ...	30	96	3	19	4	-	152
	Net tons	5,126	52,095	1,198	12,972	335	—	71,726
	Gross tons	11,371	108,094	10,383	30,616	743	—	161,207
	d.w. tons...	13,672	142,829	1,560	16,591	790	—	175,412
PARTLY IN COASTING AND PARTLY IN HOME TRADE.	Number of Vessels ...	243	12	—	4	3	—	262
	Net tons	103,260	4,887	—	2,773	1,036	—	111,956
	Gross tons	199,477	10,648	—	6,322	2,100	—	218,517
	d.w. tons...	281,589	14,050	—	5,662	2,675	—	303,976
FOREIGN TRADE ONLY (EXCLUDING TRADE BETWEEN ELBE AND BREST LIMITS).	Number of Vessels ...	745	912	66	341	225	—	2,289
	Net tons	2,018,100	3,141,227	663,539	1,866,509	891,761	—	8,581,136
	Gross tons	3,280,600	5,054,893	1,200,877	3,112,524	1,471,225	—	14,120,119
	d.w. tons...	5,621,400	7,448,966	682,720	2,896,550	2,212,959	—	18,862,595
PARTLY IN HOME AND PARTLY IN FOREIGN TRADE.	Number of Vessels ...	120	43	—	—	88	—	251
	Net tons	147,931	89,722	—	—	307,823	—	545,476
	Gross tons	254,576	147,660	—	—	520,583	—	922,819
	d.w. tons...	401,767	246,700	—	—	807,761	—	1,456,228
TOTAL.	Number of Vessels ...	1,366	1,175	99	408	340	80	3,468
	Net tons	2,359,184	3,330,645	678,839	1,914,393	1,206,037	42,538	9,531,636
	Gross tons	3,902,527	5,415,509	1,238,308	3,220,805	2,005,432	63,069	15,845,650
	d.w. tons...	6,541,765	7,967,171	684,280	2,963,723	3,035,289	58,015	21,250,243
LAID UP TONNAGE INCLUDED IN THE ABOVE.	Number of Vessels ...	266	136	14	25	73	—	514
	Net tons	607,636	444,526	50,443	126,998	259,828	—	1,489,431
	Gross tons	992,705	725,028	92,084	200,320	428,261	—	2,438,398
	d.w. tons...	1,646,497	1,062,735	53,513	172,560	636,383	—	3,571,688

TABLE IV

Classification of United Kingdom Tonnage on June 30, 1936

TYPE OF TONNAGE

Owned or Managed on June 30, 1936, and Usually Engaged in the		Tramp	Cargo Liner	Passenger Liner	Mixed Cargo and Passenger Liner	Tanker	Other	Total
COASTING TRADE ONLY.	No. of Vessels	289	111	20	49	29	—	498
	Net tons	108,680	42,276	18,805	32,065	20,642	—	222,468
	Gross tons	207,313	94,017	44,030	70,701	36,262	—	452,323
	d.w. tons...	289,668	111,969	3,365	45,217	40,609	—	493,828
HOME TRADE ONLY (ELBE AND BREST LIMITS).	No. of Vessels	44	120	32	38	1	—	235
	Net tons	17,604	61,074	23,020	36,856	254	—	138,808
	Gross tons	35,101	132,126	57,328	85,291	707	—	310,553
	d.w. tons...	46,038	153,756	8,316	17,792	690	—	226,592
PARTLY IN COASTING AND PARTLY IN HOME TRADE.	No. of Vessels	287	13	—	1	7	—	308
	Net tons	111,723	3,487	—	679	3,007	—	118,896
	Gross tons	224,446	7,322	—	1,374	6,322	—	239,464
	d.w. tons...	304,191	9,354	—	1,324	7,613	—	322,482
FOREIGN TRADE ONLY (EXCLUDING TRADE BETWEEN ELBE AND BREST LIMITS).	No. of Vessels	824	798	44	283	214	—	2,163
	Net tons	2,237,066	2,797,718	437,530	1,734,474	833,619	—	8,040,407
	Gross tons	3,659,527	4,557,878	750,729	2,971,927	1,393,903	—	13,333,964
	d.w. tons...	6,296,854	6,517,356	387,231	2,559,499	2,116,308	—	17,877,248
PARTLY IN HOME AND PARTLY IN FOREIGN TRADE.	No. of Vessels	126	25	—	—	93	—	244
	Net tons	117,182	91,655	—	—	317,216	—	526,053
	Gross tons	207,064	149,460	—	—	548,435	—	904,959
	d.w. tons...	312,259	202,209	—	—	827,643	—	1,342,111
TOTAL.	No. of Vessels	1,570	1,067	96	371	344	77	3,525
	Net tons	2,592,255	2,996,210	479,355	1,804,074	1,174,738	39,700	9,086,332
	Gross tons	4,333,451	4,940,803	852,087	3,129,293	1,985,629	66,772	15,308,035
	d.w. tons...	7,249,010	6,997,644	398,912	2,623,832	2,992,863	58,854	20,321,115

TABLE V

Classification of United Kingdom Tonnage on October 1, 1933

Analysis of steam and motor tonnage of 100 *gross tons and upwards on U.K. Register*

TYPE OF TONNAGE

Owned or Managed on October 1, 1933, and Usually Engaged in the		Tramp	Cargo Liner	Passenger Liner	Mixed Cargo and Passenger Liner	Tanker	Total
(1) COASTING TRADE ONLY.	No. of Vessels	286	112	58	109	21	586
	Net tons	98,539	42,711	16,817	47,207	5,507	210,814
	Gross tons	181,903	91,211	41,040	104,800	11,681	433,638
	d.w. tons...	259,576	146,626	—	86,942	12,031	505,175
(2) HOME TRADE ONLY (ELBE AND BREST LIMITS).	No. of Vessels	45	106	3	126	4	284
	Net tons	10,582	59,621	4,198	66,438	335	141,174
	Gross tons	23,471	123,715	10,383	156,791	743	315,106
	d.w. tons...	28,212	163,428	1,560	53,624	790	217,611
(3) PARTLY IN COASTING AND PARTLY IN HOME TRADE.	No. of Vessels	293	12	—	4	3	312
	Net tons	117,712	4,887	—	2,773	1,036	126,438
	Gross tons	227,477	10,648	—	6,322	2,100	246,547
	d.w. tons...	321,198	14,050	—	5,662	2,675	313,585
TOTAL OF (1), (2) AND (3).	No. of Vessels	624	230	61	239	28	1,182
	Net tons	226,863	107,222	21,045	116,418	6,878	478,426
	Gross tons	432,851	228,577	51,423	267,916	14,524	995,291
	d.w. tons...	608,986	324,104	1,560	146,228	15,496	1,096,374
(4) FOREIGN TRADE ONLY (EXCLUDING TRADE BETWEEN ELBE AND BREST LIMITS).	No. of Vessels	926	959	66	481	227	2,659
	Net tons	2,280,381	3,210,371	663,539	2,058,467	897,773	9,110,534
	Gross tons	3,707,900	5,165,493	1,200,877	3,433,524	1,481,325	14,989,119
	d.w. tons...	6,355,341	7,613,937	682,720	3,196,611	2,227,913	20,076,522
(5) PARTLY IN HOME AND PARTLY IN FOREIGN TRADE.	No. of Vessels	120	43	—	—	88	251
	Net tons	147,931	89,722	—	—	307,823	545,476
	Gross tons	254,576	117,660	—	—	520,583	922,819
	d.w. tons...	401,767	216,700	—	—	807,761	1,456,228

TOTAL OF (4) AND (5).	No. of Vessels	1,016	1,002	66	481	315	2,910
	Net tons	2,428,312	3,300,096	663,539	2,058,467	1,205,596	9,656,010
	Gross tons	3,962,476	5,313,153	1,200,877	3,433,524	2,001,908	15,911,938
	d.w. tons...	6,757,108	7,860,637	682,720	3,196,611	3,035,674	21,532,750
ADMIRALTY-OWNED VESSELS.	No. of Vessels	—	—	—	—	58	58
	Net tons	—	—	—	—	136,000	136,000 †
	Gross tons	—	—	—	—	225,960	225,960
	d.w. tons...	—	—	—	—	351,000	351,000 †
VESSELS OF OTHER TYPES BELONGING TO OWNERS IN GROUPS (1) TO (5).	No. of Vessels	—	—	—	—	—	146
	Net tons	—	—	—	—	—	68,152
	Gross tons	—	—	—	—	—	101,069
	d.w. tons...	—	—	—	—	—	92,983
TOTAL.	No. of Vessels	1,670	1,232	127	720	401	4,296
	Net tons	2,655,175	3,407,318	684,584	2,174,885	1,348,474	10,338,588
	Gross tons	4,395,327	5,541,730	1,252,300	3,701,440	2,242,392	17,234,258
	d.w. tons...	7,366,094	8,184,741	684,280	3,342,839	3,402,170	23,073,107
NON-TRADING VESSELS.*	No. of Vessels	—	—	—	—	—	2,620
	Net tons	—	—	—	—	—	303,000 †
	Gross tons	—	—	—	—	—	825,000
	d.w. tons...	—	—	—	—	—	—
BALANCE NOT ANALYSED.	No. of Vessels	—	—	—	—	—	568
	Net tons	—	—	—	—	—	122,000 †
	Gross tons	—	—	—	—	—	329,455
	d.w. tons...	—	—	—	—	—	383,300 †
TOTAL ON U.K. REGISTER.	No. of Vessels	—	—	—	—	—	7,484
	Net tons	—	—	—	—	—	10,763,588
	Gross tons	—	—	—	—	—	18,388,713
	d.w. tons...	—	—	—	—	—	23,456,907
LAID UP TONNAGE INCLUDED IN GROUPS (1) TO (5) ABOVE.	No. of Vessels	266	136	14	25	73	514
	Net tons	607,636	444,526	50,443	126,998	259,828	1,489,431
	Gross tons	992,705	725,028	92,084	200,320	428,261	2,438,398
	d.w. tons...	1,646,497	1,062,735	53,513	172,560	636,383	3,571,688

* Harbour Craft, Tugs, Dredgers, Fishing Vessels, etc. † Estimated.

TABLE VI

Classification of United Kingdom Tonnage on June 30, 1936

Analysis of steam and motor tonnage of 100 gross tons and upwards on U.K. Register

TYPE OF TONNAGE

Owned or Managed on June 30, 1936, and Usually Engaged in the		Tramp	Cargo Liner	Passenger Liner	Mixed Cargo and Passenger Liner	Tanker	Total
(1) COASTING TRADE ONLY.	No. of Vessels	407	111	45	92	30	685
	Net tons	131,880	42,276	23,805	40,465	21,142	259,568
	Gross tons	251,672	94,017	55,705	89,233	37,122	527,749
	d.w. tons...	351,768	114,969	12,665	57,117	41,509	578,028
(2) HOME TRADE ONLY (ELBE AND BREST LIMITS).	No. of Vessels	51	120	32	38	1	242
	Net tons	19,201	61,074	23,020	36,856	254	140,408
	Gross tons	38,254	132,126	57,328	85,291	707	313,706
	d.w. tons...	50,138	153,756	8,316	17,792	690	230,692
(3) PARTLY IN COASTING AND PARTLY IN HOME TRADE.	No. of Vessels	312	13	—	1	7	333
	Net tons	121,923	3,487	—	679	3,007	129,096
	Gross tons	241,988	7,322	—	1,374	6,322	260,006
	d.w. tons...	332,091	9,354	—	1,324	7,613	350,382
TOTAL OF (1), (2) AND (3).	No. of Vessels	770	244	77	131	38	1,260
	Net tons	273,007	106,837	46,825	78,000	21,403	529,072
	Gross tons	534,914	233,465	113,033	175,898	44,151	1,101,461
	d.w. tons...	733,997	278,079	20,981	76,233	49,812	1,159,102
(4) FOREIGN TRADE ONLY (EXCLUDING TRADE BETWEEN ELBE AND BREST LIMITS).	No. of Vessels	875	828	44	340 *	215	2,302
	Net tons	2,335,666	2,837,818	437,530	1,830,874	834,919	8,276,807
	Gross tons	3,821,288	4,623,175	750,729	3,136,812	1,396,089	13,728,093
	d.w. tons...	6,575,054	6,610,756	387,231	2,701,299	2,119,608	18,393,918
(5) PARTLY IN HOME AND PARTLY IN FOREIGN TRADE.	No. of Vessels	126	25	—	—	93	244
	Net tons	117,182	91,655	—	—	317,216	526,053
	Gross tons	207,064	149,460	—	—	548,435	904,959
	d.w. tons...	312,259	202,209	—	—	827,643	1,342,111

TOTAL OF (4) AND (5).	No. of Vessels	1,001	853	44	340	308	2,546
	Net tons	2,452,848	2,929,473	437,530	1,830,874	1,152,135	8,802,860
	Gross tons	4,028,352	4,772,635	750,729	3,136,812	1,944,521	14,633,052
	d.w. tons...	6,887,313	6,812,965	387,231	2,701,299	2,947,251	19,736,059
ADMIRALTY OWNED VESSELS.	No. of Vessels	—	—	—	—	57	57
	Net tons	—	—	—	—	121,261	121,261
	Gross tons	—	—	—	—	222,056	222,056
	d.w. tons...	—	—	—	—	310,144	310,144
VESSELS OF OTHER TYPES BELONGING TO OWNERS IN GROUPS (1) TO (5).	No. of Vessels	—	—	—	—	—	77
	Net tons	—	—	—	—	—	39,700
	Gross tons	—	—	—	—	—	66,772
	d.w. tons...	—	—	—	—	—	58,854
TOTAL.	No. of Vessels	1,771	1,097	121	471	403	3,940
	Net tons	2,725,855	3,036,310	484,355	1,908,874	1,297,799	9,492,893
	Gross tons	4,563,266	5,006,100	863,762	3,312,710	2,210,731	16,023,341
	d.w. tons...	7,621,310	7,091,044	408,212	2,777,532	3,307,207	21,264,159
NON-TRADING VESSELS (FISHING VESSELS, HARBOUR CRAFT, TUGS, ETC.).	No. of Vessels	—	—	—	—	—	2,732
	Net tons	—	—	—	—	—	339,052 †
	Gross tons	—	—	—	—	—	749,417
	d.w. tons...	—	—	—	—	—	—
BALANCE NOT ANALYSED.	No. of Vessels	—	—	—	—	—	360
	Net tons	—	—	—	—	—	157,898 †
	Gross tons	—	—	—	—	—	349,007
	d.w. tons...	—	—	—	—	—	394,700 †
TOTAL ON UNITED KINGDOM REGISTER.	No. of Vessels	—	—	—	—	—	7,032
	Net tons	—	—	—	—	—	9,989,843
	Gross tons	—	—	—	—	—	17,121,765
	d.w. tons...	—	—	—	—	—	21,658,859

* Including 6 Troopships of 35,582 n.t., 58,115 g.t., 58,640 d.w. † Estimated.

TABLE VII

Freights 1869 *to* 1936. *Chain Index*

The routes marked with an asterisk did not occur in any pair of consecutive years and the corresponding route numbers are accordingly omitted from the Table.

Average Freight on Each Route in any Year expressed as a Percentage of the Average Freight on the Same Route in the Preceding Year. The Numbered Routes are as follows :—

LIST OF ROUTES: (A) HOMEWARD FREIGHTS

1. Java to U.K.—Sugar.
2. Burmah to U.K.—Rice.
3. Ceylon to U.K.—Coffee.
4. Alexandria to U.K.—Cottonseed.
5. Smyrna to U.K.—Grain.
6. Danube to U.K.—Grain.
7. Odessa to U.K.—Grain.
8. Azov to U.K.—Grain.
9. Archangel to U.K.—Grain.
10. Archangel to U.K.—Deals.
11. Cronstadt to U.K.—Deals.
12. Riga to U.K.—Sleepers.
13. Riga to U.K.—Grain.
14. Montreal to U.K.—Grain.
15. St. John N.B. to U.K.—Deals.
16. N.Y., Philadelphia or Baltimore to U.K. —Grain.
17. Pensacola to U.K.—Timber.
18. West Indies to U.K.—Sugar.
19. Bombay to U.K.—Cotton.
20. Pomaron to U.K.—Sulphur Ore.
21. Rio Grande do Sul to U.K.—Hides.
22. Calcutta to U.K.—Jute.
23. Sicily to U.K.—Sulphur.
24. Carthagena to Tyne or Cardiff—Ore.
*25. Monte Video or Buenos Aires to U.K.—Hides.
26. San Francisco to U.K.—Grain.
*27. Australia to U.K.—Grain.
28. Karachi to U.K.—General.
29. Bolderaa to U.K.—Sleepers.
30. Coramandel Coast to Mediterranean—Seeds, etc.
31. Calcutta to U.K.—Wheat.
*32. Calcutta to Malabar Coast—Rice.
33. Galveston or New Orleans to Liverpool, Havre or Bremen—Cotton.
34. Charleston or Savannah to Liverpool or Cont.—Cotton.
35. Bangkok or Saigon to U.K.—Rice.
36. Bona or Benisaf to U.S.A.—Ore.
37. Porman to Wales—Ore.
38. Malabar Coast to U.K.—Coffee.
*39. San Francisco to Direct U.K.—Grain or Flour.
40. San Francisco (Sailers) to Direct U.K.—Wheat.
41. Japan to Direct U.K. or Cont.—Rice.
42. Saigon to Direct U.K. or Cont.—Rice.
43. Bangkok to Direct U.K. or Cont.—Rice.
44. Calcutta to Direct U.K. or Cont.—Light Freight.
45. Calcutta to Direct U.K. or Cont.—Deadweight.
46. Madras Coast to Direct U.K.—Jaggery, etc.
47. Madras Coast to Mediterranean—Seeds.
48. Colombo to London—Coffee, etc.
49. Bussorah to Direct U.K. or Cont.—Bussorah Scale—General.
50. Cuba to U.S.—Sugar.
51. Coosaw River to Direct U.K.—Phosphate.
52. Port Royal to Direct U.K.—Deals.
53. Montreal Direct U.K.—Deals.
*54. Philadelphia to Adriatic—Petroleum.
55. New Orleans to U.K. or Cont.—Grain.
56. Nicolaieff to U.K. or Cont.—Grain.
57. Poti to U.K. or Cont.—Grain.
58. Sulina to U.K. or Cont.—Grain.
59. Kustendji, Varna and adjacent ports to U.K. or Cont.—Grain.
60. Salonica to U.K. or Cont.—Grain.
61. Syrian Coast to U.K. or Cont.—Grain.
62. Alexandria to U.K.—Grain.
63. Sardinia to Antwerp—Ore.
64. Mediterranean Fruit Ports to U.S.—Fruit, etc.
65. Mediterranean Ore Ports to U.S.—Ore.
66. Reval to East Coast—Grain.
67. Libau to East Coast—Grain.
68. Cronstadt to East Coast—Grain.
69. China to London—Teas.
70. China to New York—Teas.
71. Manilla Direct U.K.—Hemp.
72. Manilla Direct U.K.—Sugar.
73. Galveston to Liverpool or Cont.—Cotton.
74. Australia to London—Wool.
75. Australia to London—Tin and Copper.
76. Australia to London—Ore.
77. Singapore to London—General.
78. Persian Gulf to U.K. or Cont.—General.
78*a*. Savannah to Liverpool or Cont.—Cotton.
79. Norfolk to Liverpool or Cont.—Cotton.
80. Wilmington to Liverpool or Cont.—Cotton.
81. Riga to U.K.—Deals.
82. Calcutta Direct U.K.—Linseed.
83. River Parana to U.K. or Cont.—Grain.
84. Saigon to Hong Kong—Rice.
85. Burmah Rice Ports to Malabar Coast—Rice or Paddy.
86. Rangoon or Moulmein to Bombay—Teak.
87. Poti to U.K. or Cont.—Ore.
88. Australia (Sailers) to U.K.—Wheat.
89. Manilla Direct U.K.—Sugar and Hemp.
90. Novorossisk to U.K. or Cont.—Grain.
91. Malabar Coast to Marseilles, London or Cont.—General.
92. Australia to London—General.
93. Nitrate Port to U.K. or Cont.—Nitrate.
94. Nitrate Port (Sailers) to U.K. or Cont.—Nitrate.
95. St. Petersburg to London or E.C.—Deals.
96. Fernandia Direct U.K. or Cont.—Phosphate.
97. Tampa Direct U.K. or Cont.—Phosphate.
98. W. C. S. America (Sailers) to U.K. or Cont.—Nitrate.
99. Philippines to U.K. or U.S.—Sugar, etc.
100. Rice Ports Bay of Bengal to Malabar Coast—Rice and/or Paddy.
*101. Tacoma or Portland (O) to U.K. or Cont. —Wheat.
102. W. C. S. America to U.K. or Cont.—Nitrate.

TABLE VII (*List of Routes continued*)

103. Huelva to United States—Ore (Tinto Terms).
104. Madras Coast to Marseilles—Gingelly Seed.
105. Australia to U.K. or Cont.—Wheat.
*106. River Plate to Deptford or Liverpool—Cattle.
*107. River Plate to Deptford or Liverpool—Sheep.
108. Vizagapatam to U.K. or Cont.—Ore.
109. Carthagena to Rotterdam—Ore.
110. Batoum to Calcutta or Bombay—Case Oil.
111. Philippines to U.K. or U.S.A.—Hemp.
112. Vizagapatam to U.S.A.—Manganese Ore.
113. Bombay to U.S.A.—Manganese Ore.
114. Bombay to U.K. or Cont.—Manganese Ore.
*115. Rio and/or Santos to U.S.A.—Coffee.
116. Carthagena to Maryport—Ore.
117. Bilbao to Middlesbrough—Ore.
*118. Australia to U.K. or Cont.—General.
119. Rio Janeiro to U.S.A.—Ore.
*120. Christmas Island to U.K., Cont. or Baltic—Phosphate.
121. Bulgaria to U.K. or Cont.: Picked Ports—Grain.
122. Calcutta to Bombay—Coals.
123. Portland (O) or Puget Sound to U.K. or Cont.—Grain.
124. Portland (O) (Sailers) to U.K. or Cont.—Grain.
125. Newcastle N.S.W. to Java—Coals.
126. Bahia Blanca to U.K. or Cont.—Grain.
127. Rio de Janeiro to U.K. or Cont.—Ore.
128. Newcastle N.S.W. to Philippines—Coals.
*129. Portland (O) or Puget Sound to Philippines—Grain.
*130. Portland (O) or Puget Sound (Sailers) to Philippines—Grain.
131. Philippines to U.K., Cont. or Mediterranean—Copra.
132. Dalny or Vladivostock to U.K. or Cont.—Soya Beans.
133. Bombay to U.K. or Cont.—General.
134. Colastine to U.K. or Cont.—Quebracho Wood.
135. W. C. S. America to Philippines or U.S.A.—Nitrate.
*136. W. C. S. America (Sailers) to Philippines—Nitrate.
137. Gulf Ports to River Plate—Sawn Wood.
138. U.S.A. Atlantic Ports to U.K. or Cont.—Cotton, etc.
139. U.S.A. Atlantic Ports to U.K. or Cont.—Grain.
140. U.S.A. Gulf Ports to U.K. or Cont.—Grain, Cotton, etc.
141. Calcutta to Colombo—Coal.
142. Calcutta to U.K. or Cont.—General.
*143. Buenos Ayres (Sailers) to U.K. or Cont.—Grain.
144. U.S.A. Gulf Ports to U.K., Cont. or Mediterranean—Grain.
145. Canada to W. Coast U.K.—Deals, etc.
146. Sundswall to East Coast U.K.—Deals.
147. Aden to Calcutta—Salt.
148. Buenos Ayres to U.K. or Cont.—Grain.
149. U.S.A. Atlantic Ports to U.K. or Cont.—General.
150. Bordeaux to Bristol Channel—Pitwood.
151. W. C. S. America to U.K., Cont. or Mediterranean—Nitrate.
152. Madras Coast to Marseilles—Ground Nut Kernels.
153. Buenos Ayres to U.S.A.—Grain, Seeds, etc.
154. Buenos Ayres (Sailers) to U.S.A.—Grain, Seeds, etc.
155. U.S.A. Atlantic Ports to River Plate—Coal.
156. U.S.A. Atlantic Ports (Sailers) to River Plate—Coal.
157. U.S.A. Gulf Ports (Sailers) to River Plate—Sawn Wood.
158. Philippines to U.K., Cont. or Mediterranean—General.
*159. Bombay to U.S.A.—General.
160. Canada to U.K. or Cont.—Grain.
161. U.S.A. Atlantic Ports to U.K. or Cont.—Coal.
162. U.S.A. Gulf Ports to U.K. or Cont.—Sawn Wood.
163. Carthagena to Clyde—Ore.
164. South Spain to U.K.—Fruit, etc.
165. U.S.A. Atlantic Ports to Mediterranean or Adriatic—Grain.
166. Finland to U.K.—Pit props.
*167. Japan to Singapore—Coals.
*168. Kohsichang to U.K., Cont. or Mediterranean—Rice.
169. Mauritius to U.K., Cont. or Mediterranean—Sugar.
170. Karachi to U.K. or Cont.—Wheat.
171. Cuba to U.K. or Cont.—Sugar.
172. W. C. North America to U.K., Cont. or Mediterranean—Wheat, Barley.
173. Java to Japan—Sugar.
174. Durban to Bombay or Karachi—Coal.
*175. Durban to River Plate—Coal.
176. Rosario to U.S.A.—Seeds.
177. Nicolaieff or Odessa to Cont.—Ore.
178. W. C. North America to Japan—Lumber.
179. Australia to Japan—Wheat, Flour.
180. Baltic Ports to Alexandria—Baulks, etc.
181. White Sea Ports to U.K. or Cont.—Deals, etc.
182. Santa Fe to Cont.—Quebracho Wood.
183. South Africa to U.K. or Cont.—Maize.
184. Bilbao to Cardiff—Ore.
185. Huelva to Rotterdam—Ore.
186. U.S.A. Gulf Ports to Mediterranean or Greece—Grain.
187. U.S.A. Gulf Ports to U.K. or Cont.—Grain.
188. Marmagoa to Cont.—Ore.
189. Peru to U.K. or Cont.—Sugar.
190. Australia to Shanghai—Wheat, Flour.
191. Durban to Red Sea Ports—Coal.
192. W. C. North America to Shanghai—Wheat.
193. Calcutta to Hong Kong—Coal.
194. San Domingo to U.K. or Cont.—Sugar.
195. Canada to Mediterranean or Greece—Wheat.
196. U.S.A. Atlantic Ports to Brazil—Wheat.
197. Azov to U.S.A.—Coal.
198. Poti or Nicolaieff to U.S.A.—Ore.
199. Necochea to U.K. or Cont.—Wheat, Maize.
200. Durban to Singapore—Coal.
201. Bombay to U.K., Cont. or Mediterranean—Seeds.
202. Indo-China to France—Anthracite.
203. W. C. N. America to Sydney, N.S.W.—General.
204. Bombay to U.S.A.—Seeds.
205. Odessa to Vladivostock—General.
206. Colachel to U.S.A.—Ore.
207. U.S. Atlantic Ports to Italy—Scrap.
208. U.S. Atlantic Ports to Japan—Scrap.
*209. U.S. Atlantic Ports to U.K.—Scrap.
210. Brazil to U.K. or Cont.—Sugar.
*211. Odessa to Japan—Pig Iron.

TABLE VII (*List of Routes continued*)

(B) OUTWARD FREIGHTS

1. Wales to Shanghai—Coals.
2. Wales to Singapore—Coals.
*3. Tyne to Calcutta—Coals.
*4. Wales to Galle—Coals.
5. Tyne to Bombay—Coals.
6. Tyne to Alexandria—Coals.
7. Wales to Constantinople—Coals.
8. Wales to Malta—Coals.
9. Wales to Genoa—Coals.
10. Wales to Cape of Good Hope—Coals.
11. Wales to Buenos Ayres—Coals.
12. Wales to Rio de Janeiro—Coals.
13. Wales to Jamaica—Coals.
14. Tyne, etc., to Galle—Coals.
15. Wales to Bombay—Coals.
16. Wales to Port Said—Coals.
17. Tyne, etc., to Port Said—Coals.
18. Wales to Hong Kong—Coals.
19. Wales to Colombo—Coals.
19a. Wales to Galle or Colombo—Coals.
*20. Wales to Calcutta—Coals.
21. Tyne, etc., to Malta—Coals.
22. Tyne, etc., to Genoa—Coals.
23. Tyne to Cronstadt—Coals.
24. Wales to Alexandria—Coals.
25. Wales to New Orleans—Rails, etc.
26. Wales to Gibraltar—Coals.
27. Cardiff to Saigon—Coals.
28. Cardiff to Singapore—Coals.
29. Cardiff to Rangoon—Coals or Fuel.
*30. Cardiff to Madras—Iron.
31. Cardiff to Colombo or Galle—Coals.
32. Cardiff to Bombay—Coals.
33. Tees to Bombay—Iron.
34. Tees to Kurrachee †—Rails, etc.
35. Cardiff to Aden—Coal, etc.
36. Cardiff to Perim—Coals, etc.
37. Cardiff to Port Said—Coals.
38. Cardiff to Alexandria—Coals.
39. Two loading Ports to Straits, China and Japan—General.
40. Two ports Cont. to Straits, Saigon and Tonkin—General.
*41. Tees to Calcutta—Iron.
42. Tees to Madras—Iron.
43. Tyne to Madras—Coals.
44. U.K. to Goa—General.
45. Cardiff to Kurrachee †—Coals.
*46. Tyne to Kurrachee †—Coals.
*47. Tyne to Perim—Coals.
48. Cardiff to Malta—Coals.
49. London Berth to Rangoon—General.
50. London Berth to Bombay and Kurrachee †—General.
51. Tyne to Venice—Coals.
52. Wales to Venice—Coals.
53. Antwerp and London to Rio Janeiro and Santos—General.
54. St. Petersburg to Vladivostock—General.
*55. Tees to Rangoon—Iron.
56. Tyne to Petrograd—Coals.
57. Cardiff to Massowah—Coals.
58. Cardiff to Constantinople—Coals.
59. Tyne to Constantinople—Coals.
60. Berth to River Plate—General.
61. Berth to Cape Colony Ports—General.
*62. Cardiff to Vladivostock—Fuel.
63. Wales to Boca—Coals.
*64. Wales to Rosario—Coals.
65. Two loading Ports U.K. or Cont. to Brazil—General.
*66. Cardiff to Canaries—Coals.
67. Tyne to Boca—Coals.
68. Hamburg to Northern U.S. Point—General.
69. Wales to Cape Town—Coals.
70. East Coast to Madras—Coals.
71. East Coast to Bombay—Coals.
72. East Coast to Constantinople—Coals.
73. East Coast to Alexandria—Coals.
74. East Coast to Venice—Coals.
75. East Coast to Genoa—Coals.
76. Wales to Cape Verde—Coals.
77. East Coast to Cronstadt—Coals.
*78. East Coast to Boca—Coals.
79. Wales to River Plate—Coals.
80. East Coast to River Plate—Coals.
81. Wales to Japan—Coals.
82. Wales to Hong Kong—Coals.
83. Wales to Port Arthur or Vladivostock—Coals.
*84. Wales to London—Coals.
85. Tyne, etc., to London—Coals.
*86. Wales to Cronstadt—Coals.
87. Wales to Barcelona—Coals.
88. Tyne to Barcelona—Coals.
*89. Wales to Piraeus—Coals.
90. Wales to Canaries—Coals.
91. Tyne, etc., to Cape Town—Coals.
*92. Wales to Yokohama—Coals.
93. Tyne, etc., to River Plate—Coals.
*94. Tyne to Rio de Janeiro—Coals.
95. Wales to Santos—Coals.
96. Wales to Marseilles—Coals.
97. Wales to U.S.A.—Coals.
98. Wales to U.S.A.—Pig Iron.
99. Wales to Bordeaux—Coals.
100. Wales or Tyne to Chilian Nitrate Ports—Coals.
*101. Tyne to Bordeaux—Coals.
102. Wales to Dakar—Coals.
*103. Wales to Aden—Coals.
104. Tyne to Stockholm—Coals.
105. Fowey to U.S.A.—China Clay.
106. United Kingdom to U.S.A. or Canada—Coals.
107. Rotterdam to West Italy—Coals.
108. Rotterdam to River Plate—Coals.
109. Tyne, etc., to Copenhagen—Coals.
*110. Wales to Saigon—Coals.
111. Rotterdam to Rio de Janeiro—Coals.
112. Wales to Djibouti—Coals.

† Spelling altered to Karachi in 1919.

Table VII

(A) HOMEWARD ROUTES

Years	Routes															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1870/69	93	91	–	116	–	92	112	112	89	113	131	108	170	88	98	102
1871/70	127	133	–	103	–	106	98	98	97	92	90	95	71	109	104	106
1872/71	103	105	97	96	–	88	85	91	103	100	115	107	94	103	105	114
1873/72	131	102	–	114	–	107	106	95	103	107	123	106	116	121	131	124
1874/73	–	107	–	86	–	114	77	93	96	102	81	86	85	74	101	85
1875/74	–	88	95	97	–	90	93	92	95	–	87	–	91	107	–	103
1876/75	–	89	–	102	–	112	131	124	97	–	124	–	120	79	–	92
1877/76	103	100	–	73	–	105	113	105	107	–	88	–	92	114	–	90
1878/77	88	63	60	88	–	89	75	84	92	–	92	–	77	98	–	102
1879/78	108	108	117	110	–	74	76	66	81	–	82	–	106	87	–	89
1880/79	109	121	122	79	–	90	83	94	102	–	–	–	82	96	–	94
1881/80	103	103	102	140	–	111	137	135	106	–	–	–	113	82	–	80
1882/81	83	91	78	78	–	100	74	79	–	–	–	–	97	119	–	114
1883/82	87	92	–	71	–	80	89	96	–	–	111	–	91	88	–	97
1884/83	76	74	–	94	–	88	81	81	–	–	–	–	91	–	77	83
1885/84	94	102	–	91	–	104	120	116	–	–	–	–	112	–	96	92
1886/85	84	86	–	71	–	85	97	71	–	–	–	–	79	144	85	95
1887/86	107	105	–	143	–	129	106	129	–	–	100	–	116	–	107	82
1888/87	132	106	–	137	–	127	129	130	–	–	130	–	127	–	133	133
1889/88	112	110	–	85	82	78	80	86	–	–	90	–	76	–	116	117
1890/89	79	84	–	98	–	97	84	85	–	–	72	–	84	–	65	87
1891/90	107	111	–	92	–	–	144	97	–	–	124	–	144	–	94	98
1892/91	118	82	–	93	–	84	42	59	–	–	70	–	77	100	97	93
1893/92	97	86	–	95	–	110	107	–	–	–	120	–	85	79	111	80
1894/93	106	114	–	108	–	93	104	96	–	–	86	–	82	–	–	111
1895/94	85	85	–	97	–	95	86	91	–	–	115	–	121	–	–	96
1896/95	85	74	–	117	–	128	128	131	–	–	101	–	109	–	–	121
1897/96	113	115	–	83	–	70	79	100	–	–	95	–	97	–	–	93
1898/97	118	146	–	108	–	116	113	105	–	–	113	–	104	–	–	109
1899/98	96	88	–	93	–	84	87	89	–	–	112	–	95	–	–	86
1900/99	105	102	–	111	–	143	133	134	–	–	120	125	128	–	–	122
1901/00	79	80	–	79	71	78	72	72	–	–	67	68	59	–	–	63
1902/01	87	84	–	100	99	91	95	96	–	–	96	89	96	–	–	80
1903/02	107	115	–	91	100	96	100	93	–	–	112	113	108	–	–	113
1904/03	104	109	–	98	92	91	96	95	–	–	95	93	114	–	–	111
1905/04	99	84	–	111	106	123	113	118	–	–	104	118	88	–	–	105
1906/05	90	94	–	100	100	88	95	87	–	–	114	100	107	–	–	98
1907/06	119	116	–	87	99	98	91	108	–	–	100	98	107	–	–	89
1908/07	87	68	–	75	79	70	91	77	–	–	81	83	81	–	–	81
1909/08	111	136	–	117	105	121	100	103	–	–	105	115	115	–	–	103
1910/09	90	104	–	126	128	134	126	129	–	–	109	91	87	–	–	93
1911/10	119	113	–	112	96	95	101	103	–	–	117	138	–	–	–	–
1912/11	122	116	–	145	150	155	187	164	–	–	118	122	–	–	–	–
1913/12	–	89	–	63	86	68	60	64	–	–	89	91	–	–	–	–
1914/13	–	88	–	151	–	88	66	96	–	–	73	–	–	–	–	–
1915/14	259	323	–	381	–	–	–	–	–	–	–	–	–	–	–	–
1916/15	230	261	–	242	–	–	–	–	–	203	–	–	–	135	–	–
1917/16	393	212	–	90	–	–	–	–	–	–	–	–	–	–	–	–
1918/17	124	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1919/18	31	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1920/19	44	84	–	56	–	–	–	–	–	–	–	–	–	–	–	–
1921/20	47	33	–	36	–	51	–	–	–	–	–	–	–	–	–	–
1922/21	59	79	–	76	–	70	–	–	–	–	–	–	–	–	–	–
1923/22	116	101	–	101	–	96	–	–	–	–	–	–	–	–	–	–
1924/23	92	135	–	107	–	90	–	–	–	–	–	–	–	–	–	–
1925/24	83	85	–	94	–	103	–	–	–	–	–	–	–	–	–	–
1926/25	–	102	–	198	–	148	–	–	–	–	–	–	–	–	–	–
1927/26	–	108	–	57	–	66	–	–	–	–	–	–	–	–	–	–
1928/27	96	87	–	87	–	86	–	–	–	–	–	–	–	–	–	–
1929/28	81	86	–	112	–	116	–	–	–	–	–	–	–	–	–	–
1930/29	–	81	–	92	–	86	–	–	–	–	–	–	–	–	–	–
1931/30	–	127	–	90	–	98	–	–	–	–	–	–	–	–	–	–
1932/31	–	100	–	105	–	90	–	–	–	–	–	–	–	–	–	–
1933/32	–	98	–	97	–	109	–	–	–	–	–	–	–	–	–	–
1934/33	–	104	–	105	–	101	–	–	–	–	–	–	–	–	–	–
1935/34	–	92	–	83	–	110	–	–	–	–	–	–	–	–	–	–
1936/35	–	136	–	179	–	109	–	–	–	–	–	–	–	–	–	–

TABLE VII (*continued*)

(A) HOMEWARD ROUTES

Years	Routes															
	17	18	19	21	22	23	24	26	28	29	30	31	33	34	35	36
1870/69	97	92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1871/70	101	106	85	95	–	–	–	–	–	–	–	–	–	–	–	–
1872/71	108	89	82	–	80	–	–	–	–	–	–	–	–	–	–	–
1873/72	131	–	110	–	115	–	110	–	–	–	–	–	–	–	–	–
1874/73	94	–	100	–	–	–	82	85	–	–	–	–	–	–	–	–
1875/74	–	–	92	–	–	–	–	–	91	–	–	–	–	–	–	–
1876/75	–	–	97	–	–	–	–	–	100	104	–	–	–	–	–	–
1877/76	–	–	95	–	–	–	–	–	93	93	104	77	–	–	–	–
1878/77	–	–	67	–	–	–	–	–	64	91	–	77	–	–	–	–
1879/78	–	–	108	–	–	–	–	–	100	108	–	–	97	–	–	–
1880/79	–	–	123	–	121	–	–	–	132	87	114	–	97	86	113	–
1881/80	–	–	102	–	93	–	–	–	109	100	106	–	86	100	–	–
1882/81	–	–	74	–	78	–	–	–	82	96	90	–	117	108	–	94
1883/82	–	–	92	–	100	–	–	–	86	88	87	–	93	89	–	71
1884/83	78	–	84	–	67	–	–	–	73	–	–	–	92	89	–	–
1885/84	105	–	103	–	100	–	–	–	111	–	–	–	100	93	–	–
1886/85	100	–	87	–	88	–	–	–	88	–	–	–	96	97	–	–
1887/86	81	–	98	–	102	–	–	–	86	–	–	–	87	105	–	–
1888/87	121	–	105	–	144	–	–	–	117	–	–	–	120	114	–	–
1889/88	137	–	109	–	83	–	–	–	116	–	–	–	104	110	–	–
1890/89	83	–	89	–	78	–	–	–	81	–	–	–	77	76	–	–
1891/90	86	–	112	–	123	103	–	–	102	–	–	–	–	–	–	–
1892/91	101	–	70	–	64	–	–	–	81	–	–	–	–	–	–	–
1893/92	101	–	102	–	109	–	–	–	97	–	–	–	149	–	–	–
1894/93	99	–	120	–	109	–	–	–	111	–	–	–	94	–	–	–
1895/94	100	–	76	–	71	–	–	–	85	–	–	–	97	–	88	–
1896/95	100	–	75	–	72	–	–	–	66	–	–	–	120	–	84	–
1897/96	96	–	118	–	136	–	–	–	135	–	–	–	92	–	94	–
1898/97	126	–	189	–	126	–	–	–	181	–	–	–	124	–	151	–
1899/98	91	–	67	–	94	–	–	–	74	–	–	–	92	–	96	–
1900/99	108	–	105	–	93	–	–	–	99	–	–	–	118	–	110	–
1901/00	80	–	80	–	85	–	–	–	78	–	–	–	80	–	71	–
1902/01	85	–	83	–	90	–	–	77	95	–	–	–	83	–	101	–
1903/02	101	–	129	–	97	–	–	–	112	–	–	–	104	–	–	–
1904/03	101	–	80	–	130	–	–	–	107	–	–	–	92	–	–	–
1905/04	96	–	84	–	83	–	–	–	91	–	–	–	108	–	–	–
1906/05	102	–	116	–	104	–	–	–	85	–	–	–	–	–	–	–
1907/06	101	–	88	–	89	–	–	–	128	–	–	–	–	–	–	–
1908/07	94	–	71	–	84	–	–	–	64	–	–	–	–	–	–	–
1909/08	95	–	143	–	138	–	–	–	143	–	–	–	–	–	–	–
1910/09	105	–	89	–	81	–	–	–	93	–	–	–	–	–	–	–
1911/10	104	–	130	–	143	–	–	–	120	–	–	–	–	–	–	–
1912/11	149	–	129	–	119	–	–	–	132	–	–	–	–	–	–	–
1913/12	84	–	74	–	84	–	–	–	80	–	–	–	–	–	–	–
1914/13	94	–	97	–	98	–	–	–	85	–	–	–	–	–	–	–
1915/14	237	–	463	–	351	–	–	–	440	–	–	–	–	–	–	–
1916/15	224	–	166	–	189	–	–	–	177	–	–	–	–	–	–	–
1917/16	–	–	–	–	350	–	–	–	183	–	–	–	–	–	–	–
1918/17	–	–	–	–	112	–	–	–	–	–	–	–	–	–	–	–
1919/18	–	–	–	–	26	–	–	–	–	–	–	–	–	–	–	–
1920/19	–	–	–	–	58	–	–	–	55	–	–	–	–	–	–	–
1921/20	–	–	–	–	–	–	–	–	52	–	–	–	–	–	–	–
1922/21	–	–	–	–	–	–	–	–	75	–	–	–	–	–	–	–
1923/22	–	–	–	–	–	–	–	–	108	–	–	–	–	–	–	–
1924/23	–	–	–	–	–	–	–	–	86	–	–	–	–	–	–	–
1925/24	–	–	–	–	–	–	–	–	99	–	–	–	–	–	–	–
1926/25	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1927/26	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1928/27	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1929/28	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1930/29	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1931/30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1932/31	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1933/32	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1934/33	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1935/34	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1936/35	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE VII (*continued*)

(A) HOMEWARD ROUTES

Years	Routes															
	37	38	40	41	42	43	44	45	46	47	48	49	50	51	52	53
1883/82	90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1884/83	–	73	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1885/84	–	91	95	81	101	111	112	104	103	109	91	106	100	96	94	95
1886/85	–	102	91	107	–	–	78	85	80	91	83	–	96	95	102	98
1887/86	–	100	90	94	–	–	104	105	98	93	–	–	118	87	87	91
1888/87	–	107	111	121	102	107	133	130	106	126	–	–	92	141	138	155
1889/88	–	92	108	106	104	105	92	93	107	88	–	–	113	107	103	110
1890/89	–	–	117	72	96	85	85	82	84	87	–	–	96	87	87	76
1891/90	–	–	95	117	115	–	125	117	115	114	–	–	–	86	–	94
1892/91	–	–	70	86	84	–	77	61	82	80	–	–	–	112	–	107
1893/92	100	–	98	94	85	–	–	97	86	89	–	–	–	83	–	85
1894/93	97	–	104	98	111	–	–	125	116	110	–	–	–	111	–	97
1895/94	95	–	117	84	89	–	–	75	80	88	–	–	–	91	–	102
1896/95	–	–	80	94	79	–	–	63	90	73	–	–	–	91	–	102
1897/96	99	–	103	–	101	–	–	147	74	101	–	–	–	104	–	97
1898/97	108	–	98	–	135	–	–	157	173	–	–	–	–	115	–	115
1899/98	104	–	125	–	98	–	–	86	99	–	–	–	–	97	–	97
1900/99	109	–	120	–	100	–	–	108	108	–	–	–	–	120	–	127
1901/00	67	–	94	–	80	–	–	83	–	–	–	–	–	–	–	75
1902/01	87	–	66	–	90	–	–	79	–	–	–	–	–	–	–	86
1903/02	107	–	67	–	100	–	–	102	–	–	–	–	–	–	–	108
1904/03	91	–	121	–	111	–	–	120	–	–	–	–	–	–	–	90
1905/04	114	–	109	–	95	–	–	90	–	–	–	–	–	–	–	102
1906/05	100	–	109	–	86	–	–	93	–	–	–	–	–	–	–	95
1907/06	101	–	–	–	127	–	–	107	–	–	–	–	–	–	–	114
1908/07	87	–	–	–	76	–	–	79	–	–	–	–	–	–	–	–
1909/08	97	–	–	–	134	–	–	–	–	–	–	–	–	–	–	–
1910/09	103	–	–	–	110	–	–	–	–	–	–	–	–	–	–	–
1911/10	–	–	–	–	108	–	–	–	–	–	–	–	–	–	–	–
1912/11	–	–	–	–	156	–	–	–	–	–	–	–	–	–	–	–
1913/12	–	–	–	–	80	–	–	–	–	–	–	–	–	–	–	–
1914/13	–	–	–	–	93	–	–	–	–	–	–	–	–	–	–	–
1915/14	–	–	–	–	300	–	–	–	–	–	–	–	–	–	–	–
1916/15	–	–	–	–	247	–	–	–	–	–	–	–	–	–	–	–
1917/16	–	–	–	–	188	–	–	–	–	–	–	–	–	–	–	–
1918/17	–	–	–	–	91	–	–	–	–	–	–	–	–	–	–	–
1919/18	–	–	–	–	52	–	–	–	–	–	–	–	–	–	–	–
1920/19	–	–	–	–	62	–	–	–	–	–	–	–	–	–	–	–
1921/20	–	–	–	–	48	–	–	–	–	–	–	–	–	–	–	–
1922/21	–	–	–	–	58	–	–	–	–	–	–	–	–	–	–	–
1923/22	–	–	–	–	108	–	–	–	–	–	–	–	–	–	–	–
1924/23	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1925/24	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1926/25	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1927/26	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1928/27	–	–	–	–	98	–	–	–	–	–	–	–	–	–	–	–
1929/28	–	–	–	–	80	–	–	–	–	–	–	–	–	–	–	–
1930/29	–	–	–	–	89	–	–	–	–	–	–	–	–	–	–	–
1931/30	–	–	–	–	123	–	–	–	–	–	–	–	–	–	–	–
1932/31	–	–	–	–	93	–	–	–	–	–	–	–	–	–	–	–
1933/32	–	–	–	–	98	–	–	–	–	–	–	–	–	–	–	–
1934/33	–	–	–	–	107	–	–	–	–	–	–	–	–	–	–	–
1935/34	–	–	–	–	87	–	–	–	–	–	–	–	–	–	–	–
1936/35	–	–	–	–	144	–	–	–	–	–	–	–	–	–	–	–

TABLE VII (*continued*)

(A) HOMEWARD ROUTES

Years	Routes															
	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
1885/84	103	104	85	108	100	105	74	85	96	99	99	109	158	109	–	–
1886/85	85	97	–	93	79	–	–	–	98	86	108	67	77	–	130	114
1887,86	95	138	–	135	126	–	–	–	122	146	139	150	91	–	70	91
1888/87	113	124	–	125	125	–	–	–	122	131	119	104	124	–	55	100
1889/88	121	80	–	81	85	–	–	–	91	76	83	92	79	–	191	105
1890/89	83	87	–	106	90	–	–	–	100	92	84	83	83	–	62	65
1891/90	106	131	–	–	–	–	–	–	95	93	106	147	135	–	162	123
1892/91	86	48	–	77	79	–	–	–	83	90	69	–	–	–	100	106
1893/92	82	106	–	111	100	–	–	–	108	94	103	–	–	–	105	118
1894/93	–	97	–	97	100	–	–	–	112	98	112	–	–	–	96	100
1895/94	–	91	–	87	92	–	–	–	93	107	101	–	–	–	110	100
1896/95	114	139	–	138	145	–	–	–	119	105	101	–	–	–	69	75
1897/96	99	68	–	75	69	–	–	–	91	86	–	–	–	–	101	70
1898/97	127	109	–	112	113	–	–	–	113	120	–	–	–	–	106	119
1899/98	88	96	–	89	77	–	–	–	90	83	–	–	–	–	106	96
1900/99	127	123	–	135	–	–	–	–	125	–	–	–	–	–	106	117
1901/00	66	77	–	74	–	–	–	–	73	–	–	–	–	–	113	86
1902/01	81	89	–	94	–	–	–	–	113	–	–	–	–	–	88	83
1903/02	98	97	–	96	–	–	–	–	93	–	–	–	–	–	95	90
1904/03	96	96	–	93	–	–	–	–	100	–	–	–	–	–	100	122
1905/04	114	–	–	117	–	–	–	–	109	–	–	–	–	–	101	100
1906/05	92	–	–	86	–	–	–	–	89	–	–	–	–	–	102	123
1907,06	105	–	–	97	–	–	–	–	98	–	–	–	–	–	97	111
1908,07	59	–	–	79	–	–	–	–	93	–	–	–	–	–	100	100
1909/08	91	–	–	108	–	–	–	–	101	–	–	–	–	–	100	100
1910/09	125	–	–	130	–	–	–	–	–	–	–	–	–	–	–	–
1911/10	–	–	–	103	–	–	–	–	–	–	–	–	–	–	–	–
1912/11	–	–	–	169	–	–	–	–	–	–	–	–	–	–	–	–
1913/12	–	–	–	60	–	–	–	–	–	–	–	–	–	–	–	–
1914/13	–	–	–	43	–	–	–	–	–	–	–	–	–	–	–	–
1915/14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1916/15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1917/16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1918/17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1919/18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1920/19	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1921/20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1922,21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1923/22	–	–	–	–	97	–	–	–	–	–	–	–	–	–	–	–
1924/23	–	–	–	–	101	–	–	–	–	–	–	–	–	–	–	–
1925/24	–	–	–	–	99	–	–	–	–	–	–	–	–	–	–	–
1926/25	–	–	–	–	141	–	–	–	–	–	–	–	–	–	–	–
1927/26	–	–	–	–	67	–	–	–	–	–	–	–	–	–	–	–
1928/27	–	–	–	–	77	–	–	–	–	–	–	–	–	–	–	–
1929/28	–	–	–	–	112	–	–	–	–	–	–	–	–	–	–	–
1930/29	–	–	–	–	91	–	–	–	–	–	–	–	–	–	–	–
1931/30	–	–	–	–	95	–	–	–	–	–	–	–	–	–	–	–
1932,31	–	–	–	–	93	–	–	–	–	–	–	–	–	–	–	–
1933/32	–	–	–	–	108	–	–	–	–	–	–	–	–	–	–	–
1934/33	–	–	–	–	99	–	–	–	–	–	–	–	–	–	–	–
1935/34	–	–	–	–	103	–	–	–	–	–	–	–	–	–	–	–
1936/35	–	–	–	–	139	–	–	–	–	–	–	–	–	–	–	–

TABLE VII (*continued*)

(A) HOMEWARD ROUTES

Years	Routes															
	71	72	73	74	75	76	77	78	78(*a*)	79	80	81	82	83	84	85
1886/85	114	–	90	–	–	–	–	–	–	–	–	–	–	–	–	–
1887/86	133	120	107	71	123	100	66	105	108	97	100	110	106	–	–	–
1888/87	114	117	104	120	138	122	133	125	125	116	121	127	124	97	–	–
1889/88	–	–	97	100	–	–	81	109	104	111	–	89	97	115	71	88
1890/89	–	–	71	92	–	–	96	90	73	78	–	90	82	108	120	102
1891/90	–	–	113	91	–	–	100	102	111	–	–	103	118	103	83	104
1892/91	–	–	–	–	–	–	83	87	–	99	–	72	63	82	84	82
1893/92	–	–	107	–	–	–	102	–	105	–	–	108	–	81	105	85
1894/93	–	–	100	–	–	–	98	–	97	–	–	99	–	108	150	151
1895/94	–	–	90	–	–	–	77	–	94	–	–	98	–	95	89	–
1896/95	–	–	124	77	–	–	–	–	–	–	–	108	–	93	71	–
1897/96	–	–	99	111	–	–	–	–	96	–	–	–	–	76	112	–
1898/97	–	–	114	138	–	–	–	–	114	–	–	–	–	144	189	–
1899/98	–	–	–	107	–	–	–	–	88	–	–	104	–	127	87	–
1900/99	–	–	–	–	–	–	–	–	–	–	–	133	–	93	108	–
1901/00	–	–	–	–	–	–	–	–	–	–	–	66	–	80	99	–
1902/01	–	–	–	–	–	–	–	–	–	–	–	91	–	80	76	–
1903/02	–	–	–	–	–	–	–	–	–	–	–	109	–	116	87	–
1904/03	–	–	–	–	–	–	–	–	–	–	–	96	–	110	126	–
1905/04	–	–	–	–	–	–	–	–	–	–	–	107	–	82	79	–
1906/05	–	–	–	–	–	–	–	–	–	–	–	105	–	91	89	–
1907/06	–	–	–	–	–	–	–	–	–	–	–	92	–	110	146	–
1908/07	–	–	–	–	–	–	–	–	–	–	–	88	–	86	61	–
1909/08	–	–	–	–	–	–	–	–	–	–	–	111	–	90	107	–
1910/09	–	–	–	–	–	–	–	–	–	–	–	100	–	92	126	–
1911/10	–	–	–	–	–	–	–	–	–	–	–	117	–	114	96	–
1912/11	–	–	–	–	–	–	–	–	–	–	–	130	–	200	121	–
1913/12	–	–	–	–	–	–	–	–	–	–	–	89	–	84	150	–
1914/13	–	–	–	–	–	–	–	–	–	–	–	–	–	170	84	–
1915/14	–	–	–	–	–	–	–	–	–	–	–	–	–	241	144	–
1916/15	–	–	–	–	–	–	–	–	–	–	–	–	–	175	266	–
1917/16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	113	–
1918/17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	141	–
1919/18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1920/19	–	–	–	–	–	–	–	–	–	–	–	–	–	73	–	–
1921/20	–	–	–	–	–	–	–	–	–	–	–	–	–	34	–	–
1922/21	–	–	–	–	–	–	–	–	–	–	–	–	–	72	–	–
1923/22	–	–	–	–	–	–	–	–	–	–	–	–	–	95	–	–
1924/23	–	–	–	–	–	–	–	–	–	–	–	–	–	105	–	–
1925/24	–	–	–	–	–	–	–	–	–	–	–	–	–	67	–	–
1926/25	–	–	–	–	–	–	–	–	–	–	–	–	–	197	–	–
1927/26	–	–	–	–	–	–	–	–	–	–	–	–	–	76	–	–
1928/27	–	–	–	–	–	–	–	–	–	–	–	–	–	87	–	–
1929/28	–	–	–	–	–	–	–	–	–	–	–	–	–	85	–	–
1930/29	–	–	–	–	–	–	–	–	–	–	–	–	–	82	–	–
1931/30	–	–	–	–	–	–	–	–	–	–	–	–	–	114	–	–
1932/31	–	–	–	–	–	–	–	–	–	–	–	–	–	91	–	–
1933/32	–	–	–	–	–	–	–	–	–	–	–	–	–	94	–	–
1934/33	–	–	–	–	–	–	–	–	–	–	–	–	–	105	–	–
1935/34	–	–	–	–	–	–	–	–	–	–	–	–	–	101	–	–
1936/35	–	–	–	–	–	–	–	–	–	–	–	–	–	161	–	–

TABLE VII (*continued*)

(A) HOMEWARD ROUTES

Years	Routes															
	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	102
1889/88	95	91	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1890/89	78	86	111	79	72	–	–	–	–	–	–	–	–	–	–	–
1891/90	114	91	100	113	107	–	–	–	–	–	–	–	–	–	–	–
1892/91	76	85	64	82	75	98	–	–	–	–	–	–	–	–	–	–
1893/92	100	108	133	97	107	–	94	–	–	–	–	–	–	–	–	–
1894/93	118	101	96	99	107	–	98	89	100	84	–	–	–	–	–	–
1895/94	95	97	95	–	90	100	–	–	–	78	91	103	–	–	–	–
1896/95	77	97	–	–	122	–	–	–	–	124	101	113	102	86	82	–
1897/96	111	95	–	–	83	–	–	–	–	82	105	82	104	83	125	–
1898/97	139	121	–	–	105	–	–	–	–	100	123	133	113	180	–	108
1899/98	96	98	–	–	92	–	–	–	–	112	62	94	103	87	–	94
1900/99	80	124	–	–	129	–	–	–	–	117	134	116	118	109	–	102
1901/00	–	–	83	–	73	–	–	–	–	67	60	72	77	–	–	83
1902/01	–	–	91	94	99	–	–	–	–	84	98	87	75	–	–	76
1903/02	–	–	81	101	96	–	–	–	–	102	93	97	76	–	–	108
1904/03	–	–	114	87	93	–	–	–	–	131	96	95	135	–	–	100
1905/04	–	–	95	116	112	–	–	–	–	103	107	109	96	–	–	97
1906/05	–	–	103	110	88	–	–	–	–	95	84	94	95	–	–	87
1907/06	–	–	106	86	102	–	–	–	–	93	109	101	84	–	–	90
1908/07	–	–	90	80	76	–	–	–	–	95	94	68	100	–	–	93
1909/08	–	–	103	105	112	–	–	–	–	88	83	97	–	–	–	–
1910/09	–	–	88	101	124	–	–	–	–	136	110	102	–	–	–	–
1911/10	–	–	108	120	103	–	–	–	–	113	105	94	106	–	–	118
1912/11	–	–	133	167	176	–	–	–	–	114	150	164	129	–	–	150
1913/12	–	–	96	68	62	–	–	–	–	85	87	77	104	–	–	99
1914/13	–	–	78	73	107	–	–	–	–	71	85	92	91	–	–	130
1915/14	–	–	267	–	–	–	–	–	–	–	–	–	263	–	–	194
1916/15	–	–	152	–	–	–	–	–	–	–	–	–	194	–	–	150
1917/16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1918/17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1919/18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1920/19	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1921/20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1922/21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1923/22	–	101	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1924/23	–	92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1925/24	–	83	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1926/25	–	123	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1927/26	–	94	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1928/27	–	73	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1929/28	–	128	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1930/29	–	83	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1931/30	–	101	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1932/31	–	93	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1933/32	–	96	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1934/33	–	99	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1935/34	–	112	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1936/35	–	116	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table VII (*continued*)

(A) HOMEWARD ROUTES

Years	Routes															
	103	104	105	108	109	110	111	112	113	114	116	117	119	121	122	123
1898/97	119	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1899/98	111	102	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1900/99	94	96	106	–	–	–	–	–	–	–	–	–	–	–	–	–
1901/00	85	78	93	–	–	75	–	–	–	–	–	–	–	–	–	–
1902/01	115	89	–	–	–	91	89	94	89	93	100	94	–	–	–	–
1903/02	97	103	–	–	–	93	105	–	99	106	100	97	111	–	–	–
1904/03	89	113	98	–	–	92	113	–	107	102	82	93	101	–	–	–
1905/04	107	95	100	–	–	–	81	87	93	107	110	119	114	–	–	–
1906/05	106	105	100	–	–	–	125	103	93	99	117	104	84	99	–	–
1907/06	97	96	108	–	–	–	–	110	109	108	92	92	110	88	122	–
1908/07	74	82	80	–	–	–	–	74	85	83	78	86	–	83	93	74
1909/08	109	127	120	–	–	–	–	122	109	–	107	102	–	104	113	–
1910/09	131	105	94	–	–	–	–	99	107	–	106	103	–	144	88	–
1911/10	97	110	112	–	–	–	–	112	111	–	104	108	–	103	134	–
1912/11	104	121	136	–	–	–	–	130	119	–	125	118	–	168	140	–
1913/12	89	88	100	–	–	–	–	–	91	–	86	87	–	62	95	–
1914/13	99	78	69	–	–	–	–	–	91	83	78	112	–	74	81	–
1915/14	141	469	396	–	–	–	–	–	393	329	–	267	–	–	–	–
1916/15	147	179	110	–	–	–	–	–	178	161	–	143	–	–	–	177
1917/16	146	–	–	–	–	–	–	–	–	136	–	–	–	–	–	–
1918/17	137	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1919/18	56	–	–	–	–	–	–	–	–	–	–	79	–	–	–	–
1920/19	82	–	75	–	–	–	–	–	–	–	–	115	–	–	–	–
1921/20	72	–	52	–	–	–	–	–	–	–	–	32	–	–	63	52
1922/21	112	–	67	–	76	–	–	–	–	–	–	84	–	–	–	–
1923/22	99	–	84	–	89	–	–	–	–	–	–	105	–	–	–	–
1924/23	94	–	107	–	116	–	–	–	–	–	–	88	–	–	98	–
1925/24	98	–	104	–	94	–	–	–	–	–	–	87	–	–	84	–
1926/25	112	–	93	–	–	–	–	–	–	–	–	–	–	–	123	–
1927/26	101	–	112	–	–	–	–	–	–	–	–	–	–	–	97	–
1928/27	95	–	89	–	–	–	–	–	–	–	–	–	–	–	89	–
1929/28	124	–	86	–	–	–	–	–	–	–	–	–	–	–	104	–
1930/29	79	–	89	–	–	–	–	–	–	–	–	–	–	–	78	–
1931/30	98	–	100	–	–	–	–	–	–	–	–	–	–	–	106	–
1932/31	105	–	90	–	–	–	–	–	–	–	–	96	–	–	99	–
1933/32	99	–	93	–	–	–	–	–	–	–	–	103	–	–	93	–
1934/33	98	–	104	–	–	–	–	–	–	–	–	103	–	–	113	–
1935/34	102	–	92	–	–	–	–	–	–	–	–	100	–	–	94	–
1936/35	117	–	152	123	–	–	–	–	–	–	–	145	–	–	99	–

TABLE VII (*continued*)

(A) HOMEWARD ROUTES

Years	Routes															
	124	125	126	127	128	131	132	133	134	135	137	138	139	140	141	142
1908/07	84	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1909/08	–	–	92	85	–	–	–	–	–	–	–	–	–	–	–	–
1910/09	–	–	87	100	85	88	101	107	117	–	–	–	–	–	–	–
1911/10	118	–	114	97	–	118	111	111	86	–	115	–	–	–	–	–
1912/11	128	–	192	–	–	133	117	129	188	–	130	158	142	168	–	–
1913/12	100	–	84	–	–	94	82	85	87	–	83	95	85	94	–	–
1914/13	87	77	141	–	–	97	110	79	73	–	80	122	161	102	–	–
1915/14	231	139	298	–	–	268	218	395	–	–	280	314	268	906		–
1916/15	173	–	178	–	–	–	235	261	–	–	150	229	163	169	187	–
1917/16	–	–	–	–	–	299	–	162	–	–	–	–	186	–	–	–
1918/17	–	–	–	–	–	–	–	–	–	–	–	–	151	–	–	–
1919/18	–	–	–	–	–	–	–	–	–	–	–	–	24	–	–	–
1920/19	–	–	–	–	–	–	–	64	–	–	71	–	86	–	–	–
1921/20	–	53	–	–	–	–	44	29	–	49	–	–	49	50	–	–
1922/21	–	48	–	–	–	–	67	74	–	96	72	–	62	58	–	–
1923/22	–	96	–	–	–	–	91	124	–	105	90	–	89	–	–	–
1924/23	–	82	–	–	–	–	102	91	–	116	99	–	115	–	–	103
1925/24	–	93	–	–	–	–	89	93	–	84	93	–	83	–	–	97
1926/25	–	88	–	–	–	–	104	108	–	122	130	–	156	–	–	–
1927/26	–	89	–	–	–	–	110	98	–	105	84	–	62	–	–	–
1928/27	–	–	–	–	–	–	99	91	–	87	96	–	119	–	–	–
1929/28	–	–	–	–	–	–	79	92	–	98	103	–	81	–	–	–
1930/29	–	–	–	–	–	–	87	86	–	80	91	–	69	–	–	–
1931/30	–	–	–	–	–	–	116	115	–	–	–	–	107	–	–	–
1932/31	–	–	–	–	–	–	108	–	–	–	–	–	99	–	–	–
1933/32	–	–	–	–	–	–	87	–	–	–	–	–	87	–	–	114
1934/33	–	–	103	–	–	–	102	–	–	–	–	–	98	–	–	–
1935/34	–	–	101	–	–	–	85	–	–	–	–	–	115	–	–	–
1936/35	–	–	163	–	–	–	152	–	–	–	–	–	113	–	–	–

Years	Routes															
	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	160
1916/15	122	–	153	–	–	–	–	–	–	–	–	–	–	–	–	–
1917/16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1918/17	–	–	–	97	71	123	81	139	85	103	99	78	70	82	–	–
1919/18	–	–	–	59	90	66	129	93	–	111	–	81	–	–	–	–
1920/19	–	82	–	82	72	–	146	42	–	–	–	38	–	–	41	87
1921/20	–	51	–	86	28	–	45	60	–	–	–	35	–	–	41	45
1922/21	–	56	–	108	80	–	87	61	70	–	–	–	–	–	65	64
1923/22	–	98	–	78	71	–	103	98	98	–	–	–	–	–	104	88
1924/23	–	102	–	–	134	–	89	84	109	–	–	–	–	–	100	109
1925/24	–	91	–	–	80	–	99	74	90	–	–	–	–	–	90	81
1926/25	–	98	–	–	162	–	139	126	104	–	–	–	–	–	119	195
1927/26	–	114	–	–	93	–	64	121	110	–	–	–	–	–	96	53
1928/27	–	88	–	–	84	–	104	82	86	–	–	–	–	–	96	112
1929/28	–	121	–	–	83	–	108	97	82	–	–	–	–	–	94	73
1930/29	–	89	–	–	86	–	81	90	83	–	–	–	–	–	77	72
1931/30	–	80	–	–	112	–	90	102	–	–	–	–	–	–	111	104
1932/31	–	97	–	–	92	–	100	97	–	–	–	–	–	–	100	107
1933/32	–	96	–	–	98	–	–	96	94	–	–	–	–	–	99	86
1934/33	–	105	–	–	96	–	–	87	103	–	–	–	–	–	99	91
1935/34	–	100	–	–	100	–	–	103	95	–	–	–	–	–	97	123
1936/35	–	119	–	106	147	–	–	94	144	–	–	–	–	–	119	128

TABLE VII (*continued*)

(A) HOMEWARD ROUTES

Years	Routes															
	161	162	163	164	165	166	169	170	171	172	173	174	176	177	178	179
1920/19	–	80	136	33	–	–	–	–	–	–	–	–	–	–	–	–
1921/20	38	66	–	45	33	40	–	–	–	–	–	–	–	–	–	–
1922/21	–	69	–	62	71	82	69	–	–	–	–	–	–	–	–	–
1923/22	–	97	–	90	89	89	107	–	89	94	93	86	104	114	–	–
1924/23	105	102	–	114	99	101	96	–	109	100	121	98	109	91	80	94
1925/24	98	96	–	95	91	94	88	–	86	98	83	79	75	95	95	88
1926/25	200	79	–	–	119	115	122	–	104	103	99	114	120	165	106	100
1927/26	51	130	–	–	–	91	100	–	99	97	–	106	–	60	101	127
1928/27	80	85	–	–	–	95	86	93	91	91	–	89	–	89	83	79
1929/28	95	104	–	–	–	115	95	–	97	90	–	107	–	117	93	–
1930/29	85	93	–	–	–	83	90	–	73	74	–	80	–	82	78	–
1931/30	103	87	–	–	–	91	81	–	109	111	–	–	–	93	104	–
1932/31	–	–	–	–	–	86	106	–	102	91	–	–	–	93	–	–
1933/32	–	–	–	91	–	–	96	–	97	92	–	–	–	100	–	–
1934/33	–	–	–	–	–	–	102	–	95	99	–	–	–	100	–	–
1935/34	–	–	–	–	–	–	92	–	115	95	–	–	–	100	–	–
1936/35	–	–	–	–	–	–	–	–	105	135	–	–	–	122	–	–

Years	Routes															
	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195
1924/23	103	101	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1925/24	–	88	83	–	–	–	–	–	–	–	–	–	–	–	–	–
1926/25	–	112	–	92	–	–	–	–	–	–	–	–	–	–	–	–
1927/26	–	102	–	106	103	67	–	–	–	–	–	–	–	–	–	–
1928/27	–	98	–	91	94	99	91	89	–	–	–	–	–	–	–	–
1929/28	–	112	–	92	107	109	102	87	–	–	–	–	–	–	–	–
1930/29	–	93	–	78	84	82	72	73	89	–	–	–	–	–	–	–
1931/30	–	83	–	105	–	96	102	89	98	–	–	–	–	–	–	–
1932/31	–	86	–	93	–	105	101	131	103	92	89	95	–	–	–	–
1933/32	–	–	–	102	–	111	–	–	102	96	89	–	92	85	98	66
1934/33	–	–	–	95	–	98	–	–	101	103	96	–	96	83	100	–
1935/34	–	–	–	95	–	112	–	–	88	–	102	–	67	–	92	–
1936/35	–	–	–	114	–	139	–	–	161	–	–	–	118	–	135	–

Years	Routes													
	196	197	198	199	200	201	202	203	204	205	206	207	208	210
1931/30	–	–	–	123	–	–	–	–	–	–	–	–	–	–
1932/31	–	–	–	87	–	–	–	–	–	–	–	–	–	–
1933/32	76	98	87	90	–	–	–	–	–	–	–	–	–	–
1934/33	112	93	95	98	89	100	97	–	–	–	–	–	–	–
1935/34	–	114	102	106	116	101	94	83	97	107	–	–	–	–
1936/35	–	116	115	144	97	140	125	126	–	–	110	108	141	86

TABLE VII (*continued*)

(B) OUTWARD ROUTES

Years	Routes															
	1	2	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1870/69	90	100	–	104	94	114	83	92	97	104	130	–	–	–	–	–
1871/70	108	95	–	84	94	88	89	96	93	100	100	100	94	–	–	–
1872/71	–	107	–	112	110	98	117	102	102	111	98	96	98	–	–	–
1873/72	–	120	–	97	103	107	103	132	123	124	113	133	106	101	–	115
1874/73	–	94	–	95	102	91	96	101	84	86	–	113	94	96	–	82
1875/74	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1876/75	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1877/76	–	120	–	–	–	121	116	–	–	–	–	–	109	124	–	–
1878/77	–	99	–	103	84	98	103	–	–	–	–	–	146	98	–	–
1879/78	–	107	–	–	86	86	92	–	–	–	–	–	91	87	–	–
1880/79	–	85	80	–	123	123	105	–	–	–	–	–	86	119	–	–
1881/80	–	85	80	–	–	–	–	–	–	–	–	–	73	86	–	–
1882/81	–	99	100	–	–	–	–	–	–	–	–	–	106	89	–	–
1883/82	–	116	100	–	–	103	–	–	–	–	–	–	93	110	–	–
1884/83	–	–	109	–	–	–	–	–	–	–	–	–	–	122	–	–
1885/84	–	–	86	92	–	–	–	–	–	–	–	–	–	91	–	–
1886/85	–	–	–	95	–	–	–	–	–	–	–	–	–	–	–	–
1887/86	–	–	–	97	–	–	–	–	–	–	–	–	–	–	–	–
1888/87	–	–	118	104	–	–	104	–	–	–	–	–	–	–	–	–
1889/88	–	–	76	113	–	–	107	–	–	–	–	–	–	–	–	–
1890/89	–	–	93	80	–	–	78	–	–	–	–	–	–	–	–	–
1891/90	–	–	67	89	–	–	98	–	–	–	–	–	–	–	–	–
1892/91	–	–	97	98	–	–	89	–	–	–	–	–	–	–	–	–
1893/92	–	–	93	89	–	–	90	–	–	103	–	–	–	–	–	–
1894/93	–	–	92	84	–	–	86	–	–	82	–	–	–	–	–	–
1895/94	–	–	109	102	–	–	104	–	–	88	–	–	–	–	–	–
1896/95	–	–	–	–	–	–	118	–	–	125	–	–	–	–	–	–
1897/96	–	98	–	–	126	–	114	–	–	103	–	–	103	113	–	–
1898/97	–	106	–	–	106	–	106	–	–	110	–	–	92	110	–	–
1899/98	–	88	–	–	104	–	106	–	–	79	–	–	98	115	–	–
1900/99	–	120	–	–	115	–	110	–	–	130	–	–	159	114	–	–
1901/00	–	82	–	–	–	–	67	–	–	76	–	–	54	60	–	–
1902/01	80	83	–	73	–	–	80	–	–	86	–	–	90	72	–	–
1903/02	109	92	–	107	100	–	107	–	–	84	–	–	85	110	–	–
1904/03	101	93	–	95	91	–	97	–	–	94	–	–	90	92	–	–
1905/04	81	98	–	110	126	–	117	–	–	122	–	–	109	120	–	–
1906/05	–	135	–	108	95	–	104	–	–	121	–	–	113	94	–	–
1907/06	–	80	–	109	105	–	107	–	–	96	–	–	96	107	–	–
1908/07	–	98	–	93	94	–	84	–	–	81	–	–	122	96	–	–
1909/08	–	79	–	91	91	–	106	–	–	102	–	–	71	93	–	–
1910/09	–	114	–	108	108	–	104	–	–	144	–	–	110	113	–	–
1911/10	–	136	–	124	139	–	135	–	–	113	–	–	112	128	–	–
1912/11	–	121	–	137	123	–	121	–	–	117	–	–	119	126	–	–
1913/12	–	82	–	85	97	–	87	–	–	85	–	–	101	95	–	–
1914/13	–	–	–	94	77	–	128	–	–	90	–	–	118	141	–	–
1915/14	–	–	–	410	–	–	365	–	–	213	–	–	263	320	–	–
1916/15	–	–	–	198	–	–	179	–	–	175	–	–	–	191	–	–
1917/16	–	–	–	139	–	–	–	–	–	–	–	–	–	139	163	–
1918/17	–	–	–	–	–	–	–	–	–	–	–	–	–	167	143	–
1919/18	–	–	–	–	–	–	–	–	–	45	–	–	–	61	74	–
1920/19	–	–	–	–	–	–	67	–	–	80	–	–	–	80	63	–
1921/20	–	–	–	–	29	–	36	–	–	41	–	–	–	32	32	–
1922/21	–	103	111	90	86	–	76	–	–	90	–	–	89	84	100	–
1923/22	–	72	–	81	77	–	93	–	–	105	–	–	73	87	78	–
1924/23	–	118	–	98	97	–	90	–	–	81	–	–	105	96	102	–
1925/24	–	84	–	86	95	–	84	–	–	104	–	–	87	86	79	–
1926/25	–	114	–	122	121	–	127	–	–	127	–	–	–	117	120	–
1927/26	–	110	–	94	93	–	87	–	–	70	–	–	–	100	98	–
1928/27	–	89	–	95	90	–	92	–	–	97	–	–	–	105	97	–
1929/28	–	102	–	100	107	–	99	–	–	121	–	–	–	88	102	–
1930/29	–	–	–	68	62	–	76	–	–	88	–	–	–	69	68	–
1931/30	–	–	–	98	95	–	98	–	–	70	–	–	–	93	97	–
1932/31	–	–	–	95	99	–	96	–	–	96	–	–	–	98	95	–
1933/32	–	–	–	90	–	–	98	–	–	104	–	–	–	87	94	–
1934/33	–	–	–	114	–	–	108	–	–	97	–	–	–	117	104	–
1935/34	–	–	–	116	–	–	126	–	–	97	–	–	–	119	126	–
1936/35	–	–	–	85	–	–	83	–	–	108	–	–	–	81	84	–

TABLE VII (*continued*)

(B) OUTWARD ROUTES

Years	Routes															
	19	19(*a*)	21	22	23	24	25	26	27	28	29	31	32	33	34	35
1878/77	–	149	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1879/78	–	101	–	–	–	87	–	–	–	–	–	–	–	–	–	–
1880/79	–	80	–	105	–	111	–	–	–	–	–	–	–	–	–	–
1881/80	–	83	–	–	–	92	–	–	–	–	–	–	–	–	–	–
1882/81	–	96	–	–	–	91	90	–	–	–	–	–	–	–	–	–
1883/82	–	96	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1884/83	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1885/84	–	–	89	–	–	–	–	–	86	87	–	89	95	81	89	96
1886/85	–	–	–	–	–	–	–	–	–	93	–	93	88	94	92	86
1887/86	–	–	–	–	–	–	–	107	–	112	172	127	134	128	132	150
1888/87	–	–	–	101	–	–	–	100	–	130	–	118	113	111	116	107
1889/88	–	–	–	104	–	–	–	110	–	85	–	87	81	88	82	86
1890/89	–	–	–	82	–	–	–	92	–	83	–	79	88	–	–	82
1891/90	–	–	–	90	–	–	–	98	–	78	–	70	64	–	–	65
1892/91	–	–	–	101	–	–	–	92	–	90	–	104	108	–	–	–
1893/92	–	–	–	87	–	–	–	86	–	103	–	100	90	–	–	–
1894/93	–	–	–	82	–	–	–	90	–	79	–	85	96	–	–	–
1895/94	–	–	–	105	–	–	–	–	–	104	–	105	105	–	–	–
1896/95	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1897/96	88	–	–	–	–	120	–	–	–	–	–	–	–	–	–	–
1898/97	89	–	–	–	–	106	–	–	–	–	–	–	–	–	–	–
1899/98	109	–	–	–	–	118	–	–	–	–	–	–	–	–	–	–
1900/99	136	–	–	–	–	108	–	–	–	–	–	–	–	–	–	–
1901/00	63	–	–	–	–	63	–	–	–	–	–	–	–	–	–	–
1902/01	89	–	–	72	73	76	–	–	–	–	–	–	–	–	–	–
1903/02	85	–	–	112	100	107	–	–	–	–	–	–	–	–	–	–
1904/03	84	–	–	96	97	92	–	–	–	–	–	–	–	–	–	–
1905/04	117	–	–	114	123	122	–	–	–	–	–	–	–	–	–	–
1906/05	109	–	–	103	87	98	–	–	–	–	–	–	–	–	–	–
1907/06	87	–	–	111	106	112	–	–	–	–	–	–	–	–	–	–
1908/07	117	–	–	87	87	84	–	–	–	–	–	–	–	–	–	–
1909/08	71	–	–	100	107	106	–	–	–	–	–	–	–	–	–	–
1910/09	120	–	–	107	91	99	–	–	–	–	–	–	–	–	–	–
1911/10	113	–	–	126	151	124	–	–	–	–	–	–	–	–	–	–
1912/11	121	–	–	121	105	130	–	–	–	–	–	–	–	–	–	–
1913/12	89	–	–	90	98	96	–	–	–	–	–	–	–	–	–	–
1914/13	126	–	–	160	82	138	–	–	–	–	–	–	–	–	–	–
1915/14	275	–	–	286	–	336	–	–	–	–	–	–	–	–	–	–
1916/15	–	–	–	197	–	187	–	–	–	–	–	–	–	–	–	–
1917/16	–	–	–	98	–	139	–	–	–	–	–	–	–	–	–	–
1918/17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1919/18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1920/19	–	–	–	76	–	80	–	–	–	–	–	–	–	–	–	–
1921/20	–	–	–	33	–	41	–	–	–	–	–	–	–	–	–	–
1922/21	95	–	–	75	–	70	–	–	–	–	–	–	–	–	–	–
1923/22	73	–	–	84	–	80	–	–	–	–	–	–	–	–	–	–
1924/23	105	–	–	97	–	102	–	–	–	–	–	–	–	–	–	–
1925/24	86	–	–	81	–	92	–	–	–	–	–	–	–	–	–	–
1926/25	118	–	–	133	–	109	–	–	–	–	–	–	–	–	–	–
1927/26	100	–	–	84	–	103	–	–	–	–	–	–	–	–	–	–
1928/27	85	–	–	93	–	90	–	–	–	–	–	–	–	–	–	–
1929/28	127	–	–	106	–	103	–	–	–	–	–	–	–	–	–	–
1930/29	75	–	–	73	–	66	–	–	–	–	–	–	–	–	–	–
1931/30	80	–	–	93	–	95	–	–	–	–	–	–	–	–	–	–
1932/31	95	–	–	104	–	97	–	–	–	–	–	–	–	–	–	–
1933/32	95	–	–	102	–	97	–	–	–	–	–	–	–	–	–	–
1934/33	96	–	–	100	–	107	–	–	–	–	–	–	–	–	–	–
1935/34	–	–	–	118	–	125	–	–	–	–	–	–	–	–	–	–
1936/35	–	–	–	97	–	77	–	–	–	–	–	–	–	–	–	–

Table VII (*continued*)

(B) OUTWARD ROUTES

Years	Routes															
	36	37	38	39	40	42	43	44	45	48	49	50	51	52	53	54
1885,84	94	91	95	–	–	–	–	–	–	–	–	–	–	–	–	–
1886/85	–	–	100	103	101	93	–	106	97	97	–	–	–	–	–	–
1887/86	–	96	98	116	109	107	–	–	129	111	110	136	92	97	121	–
1888/87	112	101	101	97	–	129	–	–	–	94	126	115	101	98	113	140
1889/88	82	117	114	97	–	85	–	–	–	114	96	86	106	107	121	62
1890/89	84	81	82	91	–	88	–	–	–	79	78	92	82	82	76	83
1891/90	57	89	81	57	–	71	–	–	–	87	72	–	96	95	75	72
1892/91	–	99	93	94	–	106	–	–	–	100	–	–	97	94	–	–
1893/92	–	88	92	92	–	109	–	–	–	86	–	–	88	91	–	–
1894/93	–	77	85	94	–	–	–	–	–	81	–	–	86	90	–	–
1895,94	–	101	105	80	–	–	101	–	–	–	–	–	98	95	–	–
1896/95	–	–	–	–	–	–	–	–	–	–	–	–	–	125	–	–
1897/96	–	–	–	–	–	–	–	–	–	–	–	–	–	111	–	–
1898/97	–	–	–	–	–	–	–	–	–	–	–	–	–	118	–	–
1899/98	–	–	–	–	–	–	–	–	–	–	–	–	–	106	–	–
1900/99	–	–	–	–	–	–	–	–	–	–	–	–	–	109	–	–
1901/00	–	–	–	–	–	–	–	–	–	–	–	–	–	67	–	–
1902/01	–	–	–	–	–	–	–	–	–	–	–	–	–	79	–	–
1903/02	–	–	–	–	–	–	–	–	–	–	–	–	–	102	–	–
1904/03	–	–	–	–	–	–	–	–	–	–	–	–	–	100	–	–
1905/04	–	–	–	–	–	–	–	–	–	–	–	–	–	106	–	–
1906/05	–	–	–	–	–	–	–	–	–	–	–	–	–	108	–	–
1907/06	–	–	–	–	–	–	–	–	–	–	–	–	–	112	–	–
1908/07	–	–	–	–	–	–	–	–	–	–	–	–	–	83	–	–
1909/08	–	–	–	–	–	–	–	–	–	–	–	–	–	102	–	–
1910/09	–	–	–	–	–	–	–	–	–	–	–	–	–	109	–	–
1911/10	–	–	–	–	–	–	–	–	–	–	–	–	–	127	–	–
1912/11	–	–	–	–	–	–	–	–	–	–	–	–	–	120	–	–
1913/12	–	–	–	–	–	–	–	–	–	–	–	–	–	96	–	–
1914/13	–	–	–	–	–	–	–	–	–	–	–	–	–	158	–	–
1915/14	–	–	–	–	–	–	–	–	–	–	–	–	–	185	–	–
1916/15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1917/16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1918/17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1919/18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1920/19	–	–	–	–	–	–	–	–	–	–	–	–	–	78	–	–
1921/20	–	–	–	–	–	–	–	–	–	–	–	–	–	32	–	–
1922/21	–	–	–	–	–	–	–	–	–	–	–	–	–	75	–	–
1923/22	–	–	–	–	–	–	–	–	–	–	–	–	–	92	–	–
1924/23	–	–	–	–	–	–	–	–	–	–	–	–	–	94	–	–
1925/24	–	–	–	–	–	–	–	–	–	–	–	–	–	84	–	–
1926/25	–	–	–	–	–	–	–	–	–	–	–	–	–	121	–	–
1927/26	–	–	–	–	–	–	–	–	–	–	–	–	–	90	–	–
1928/27	–	–	–	–	–	–	–	–	–	–	–	–	–	93	–	–
1929/28	–	–	–	–	–	–	–	–	–	–	–	–	–	98	–	–
1930,29	–	–	–	–	–	–	–	–	–	–	–	–	–	73	–	–
1931/30	–	–	–	–	–	–	–	–	–	–	–	–	–	94	–	–
1932/31	–	–	–	–	–	–	–	–	–	–	–	–	–	101	–	–
1933/32	–	–	–	–	–	–	–	–	–	–	–	–	–	92	–	–
1934/33	–	–	–	–	–	–	–	–	–	–	–	–	–	114	–	–
1935/34	–	–	–	–	–	–	–	–	–	–	–	–	–	108	–	–
1936/35	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE VII (*continued*)

(B) OUTWARD ROUTES

Years	Routes															
	56	57	58	59	60	61	63	65	67	68	69	70	71	72	73	71
1888/87	–	111	103	89	118	122	–	–	–	–	–	–	–	–	–	–
1889/88	–	90	120	113	122	103	–	–	–	–	–	–	–	–	–	–
1890/89	–	85	76	78	73	77	–	–	–	–	–	–	–	–	–	–
1891/90	–	56	101	105	77	87	–	–	–	–	–	–	–	–	–	–
1892/91	–	117	99	95	90	68	–	–	–	–	–	–	–	–	–	–
1893/92	–	–	84	79	92	119	89	95	–	–	–	–	–	–	–	–
1894/93	–	–	80	82	76	90	70	92	68	–	–	–	–	–	–	–
1895/94	–	–	106	97	–	–	109	–	–	–	–	–	–	–	–	–
1896/95	–	–	–	–	–	–	124	–	–	104	–	–	–	–	–	–
1897/96	–	–	–	–	–	–	–	–	–	97	104	114	86	133	117	109
1898/97	–	–	–	–	–	–	–	–	–	113	100	116	93	112	108	115
1899/98	–	–	–	–	–	–	–	–	–	–	111	–	98	99	119	104
1900/99	–	–	–	–	–	–	–	–	–	–	120	–	–	122	119	115
1901/00	–	–	–	–	–	–	–	–	–	–	85	–	–	–	–	–
1902/01	–	–	–	–	–	–	–	–	–	–	64	–	–	–	–	–
1903/02	–	–	–	–	–	–	–	–	–	–	86	–	–	–	–	–
1904/03	–	–	–	–	–	–	–	–	–	–	90	–	–	–	–	–
1905/04	–	–	–	–	–	–	–	–	–	–	101	–	–	–	–	–
1906/05	–	–	–	–	–	–	–	–	–	–	105	–	–	–	–	–
1907/06	–	–	–	–	–	–	–	–	–	–	99	–	–	–	–	–
1908/07	–	–	–	–	–	–	–	–	–	–	96	–	–	–	–	–
1909/08	–	–	–	–	–	–	–	–	–	–	74	–	–	–	–	–
1910/09	–	–	–	–	–	–	–	–	–	–	116	–	–	–	–	–
1911/10	–	–	–	–	–	–	–	–	–	–	126	–	–	–	–	–
1912/11	–	–	–	–	–	–	–	–	–	–	126	–	–	–	–	–
1913/12	–	–	–	–	–	–	–	–	–	–	99	–	–	–	–	–
1914/13	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1915/14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1916/15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1917/16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1918/17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1919/18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1920/19	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1921/20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1922/21	85	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1923/22	101	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1924/23	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1925/24	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1926/25	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1927/26	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1928/27	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1929/28	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1930/29	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1931/30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1932/31	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1933/32	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1934/33	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1935/34	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1936/35	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table VII (*continued*)

(B) OUTWARD ROUTES

Years	Routes															
	75	76	77	79	80	81	82	83	85	87	88	90	91	93	95	96
1897/96	120	89	113	–	–	–	–	–	–	–	–	–	–	–	–	–
1898/97	109	135	142	105	101	–	–	–	–	–	–	–	–	–	–	–
1899/98	104	97	100	74	68	–	–	–	–	–	–	–	–	–	–	–
1900/99	108	106	104	147	162	–	–	–	–	–	–	–	–	–	–	–
1901/00	–	75	–	76	–	–	69	61	–	–	–	–	–	–	–	–
1902/01	–	–	–	84	–	–	75	–	81	88	87	88	84	75	84	–
1903/02	–	–	–	83	–	–	103	–	100	99	102	104	75	87	91	102
1904/03	–	–	–	83	–	–	101	–	95	101	94	92	94	86	94	104
1905/04	–	–	–	124	–	85	82	–	123	104	106	102	–	127	120	108
1906/05	–	–	–	142	–	–	104	–	88	111	109	110	–	148	122	96
1907/06	–	–	–	101	–	–	94	–	105	106	104	95	–	97	96	111
1908/07	–	–	–	78	–	–	104	–	81	87	91	85	–	78	81	91
1909/08	–	–	–	102	–	–	69	–	104	102	96	109	–	104	105	100
1910/09	–	–	–	138	–	–	123	–	106	105	105	119	–	129	133	110
1911/10	–	–	–	119	–	–	116	–	113	125	131	126	–	125	112	127
1912/11	–	–	–	115	–	–	121	–	115	120	125	115	–	111	115	118
1913/12	–	–	–	87	–	–	100	–	94	88	88	80	–	90	81	89
1914/13	–	–	–	91	–	–	79	–	182	120	131	115	–	92	82	149
1915/14	–	–	–	189	–	–	–	–	153	253	287	253	–	183	237	290
1916/15	–	–	–	181	–	–	–	–	127	198	185	155	–	175	–	–
1917/16	–	–	–	178	–	–	–	–	121	351	252	–	–	149	–	–
1918/17	–	–	–	116	-	–	–	–	96	112	–	–	–	79	–	–
1919/18	–	–	–	46	–	–	–	–	78	30	–	–	–	–	–	–
1920/19	–	65	–	81	–	–	–	–	91	64	–	64	–	–	–	66
1921/20	–	41	–	44	–	–	–	–	58	41	–	42	–	–	–	35
1922/21	–	69	–	87	–	–	–	–	79	91	–	90	–	80	94	79
1923/22	–	99	–	102	–	–	–	–	97	100	–	95	–	99	–	93
1924/23	–	92	–	85	–	–	–	–	82	85	–	93	–	90	–	95
1925/24	–	90	–	115	–	–	–	–	101	96	–	99	–	125	–	80
1926/25	–	111	–	114	–	–	–	–	87	73	–	107	–	105	–	133
1927/26	–	97	–	74	–	–	–	–	94	96	–	94	–	78	–	87
1928/27	–	89	–	95	–	–	–	–	106	101	–	95	–	96	–	90
1929/28	–	120	–	121	–	–	–	–	94	103	–	113	–	122	–	117
1930/29	–	77	–	93	–	–	–	–	78	81	–	80	–	92	–	71
1931/30	–	92	–	70	–	–	–	–	92	84	–	91	–	68	–	102
1932/31	–	–	–	95	–	–	–	–	104	106	–	98	–	96	–	102
1933/32	–	–	–	109	–	–	–	–	115	89	–	97	–	107	–	99
1934/33	–	–	–	89	–	–	–	–	84	115	–	103	–	93	–	104
1935/34	–	–	–	101	–	–	–	–	122	107	–	104	–	99	–	101
1936/35	–	–	–	114	–	–	–	–	114	140	–	109	–	103	–	94

TABLE VII (*continued*)

(B) OUTWARD ROUTES

Years	Routes												
	97	98	99	100	102	104	105	106	107	108	109	111	112
1903/02	98	83	–	–	–	–	–	–	–	–	–	–	–
1904/03	–	–	–	–	–	–	–	–	–	–	–	–	–
1905/04	–	–	–	–	–	–	–	–	–	–	–	–	–
1906/05	–	–	–	–	–	–	–	–	–	–	–	–	–
1907/06	–	–	111	–	–	–	–	–	–	–	–	–	–
1908/07	–	–	87	–	–	–	–	–	–	–	–	–	–
1909/08	–	–	101	–	–	–	–	–	–	–	–	–	–
1910/09	–	–	99	120	–	–	–	–	–	–	–	–	–
1911/10	–	–	132	108	–	–	–	–	–	–	–	–	–
1912/11	–	–	118	119	–	–	–	–	–	–	–	–	–
1913/12	–	–	80	102	–	–	–	–	–	–	–	–	–
1914/13	–	–	155	76	–	–	–	–	–	–	–	–	–
1915/14	–	–	273	–	–	–	–	–	–	–	–	–	–
1916/15	–	–	–	–	–	–	–	–	–	–	–	–	–
1917/16	–	–	–	–	–	–	–	–	–	–	–	–	–
1918/17	–	–	95	–	111	–	–	–	–	–	–	–	–
1919/18	–	–	92	–	50	–	–	–	–	–	–	–	–
1920/19	–	–	84	–	66	97	167	–	–	–	–	–	–
1921/20	–	–	24	–	42	–	75	–	–	–	–	–	–
1922/21	–	–	82	–	89	70	85	–	–	–	–	–	–
1923/22	–	–	101	–	92	95	89	83	–	–	–	–	–
1924/23	–	–	77	–	95	86	95	93	–	–	–	–	–
1925/24	–	–	89	–	100	81	–	93	84	–	–	–	–
1926/25	–	–	96	–	102	–	–	147	129	99	–	–	–
1927/26	–	–	100	–	97	–	–	80	81	77	100	–	–
1928/27	–	–	112	–	99	–	–	76	99	93	100	–	–
1929/28	–	–	113	–	108	–	–	151	94	106	111	–	–
1930/29	–	–	78	–	80	–	–	77	74	111	74	–	–
1931/30	–	–	97	–	89	–	–	97	96	71	88	–	–
1932/31	–	–	101	–	107	–	–	100	104	–	94	–	–
1933/32	–	–	103	–	92	–	–	88	90	–	–	101	–
1934/33	–	–	95	–	109	–	–	103	126	93	–	93	–
1935/34	–	–	119	–	97	–	–	98	122	95	125	103	–
1936/35	–	–	105	–	112	–	–	98	77	119	111	115	88

TABLE VIII

Index Numbers of Tramp Shipping Freights and Wholesale Prices (Statist) 1869–1936. (Base Year 1869)

Year	FREIGHTS				STATIST PRICES			
	Freight Index (2)	Seven Years Moving Average (3)	Deviation (4)	Deviation, per cent. (5)	Price Index (6)	Seven Years Moving Average (7)	Deviation (8)	Deviation, per cent. (9)
(1)								
1869	100	—	—	—	100	—	—	—
1870	103	—	—	—	98	—	—	—
1871	102	—	—	—	102	—	—	—
1872	103	105	− 2	− 1·90	111	104	7	6·73
1873	117	104	13	12·50	113	103	10	9·71
1874	108	104	4	3·85	104	103	1	0·97
1875	99	102	− 3	− 2·94	98	101	− 3	− 2·97
1876	98	100	− 2	− 2·00	97	97	0	0
1877	99	95	4	4·21	96	94	2	2·13
1878	91	92	− 1	− 1·09	89	92	− 3	− 3·26
1879	85	90	− 5	− 5·56	85	90	− 5	− 5·56
1880	87	86	1	1·16	90	88	2	2·27
1881	87	81	6	7·41	87	86	1	1·16
1882	81	77	4	5·19	86	83	3	3·61
1883	75	74	1	1·35	84	81	3	3·70
1884	64	71	− 7	− 9·86	78	78	0	0
1885	63	69	− 6	− 8·70	73	76	− 3	− 3·95
1886	59	68	− 9	−13·24	70	74	− 4	− 5·41
1887	65	67	− 2	− 2·99	69	72	− 3	− 4·17
1888	76	66	10	15·15	71	72	− 1	− 1·39
1889	75	65	10	15·38	73	71	2	2·82
1890	64	65	− 1	− 1·54	73	71	2	2·82
1891	63	64	− 1	− 1·56	73	70	3	4·29
1892	55	62	− 7	−11·29	69	69	0	0
1893	60	59	1	1·69	69	68	1	1·47
1894	58	58	0	0	64	66	− 2	− 3·03
1895	56	58	− 2	− 3·45	63	65	− 2	− 3·08
1896	56	60	− 4	− 6·67	62	65	− 3	− 3·08
1897	56	62	− 6	− 9·68	63	66	− 3	− 4·55
1898	68	62	6	9·68	65	67	2	2·99
1899	65	61	4	6·56	69	68	1	1·47
1900	76	60	16	26·67	77	69	8	11·59
1901	57	59	− 2	− 3·39	71	70	1	1·43
1902	49	57	− 8	−14·03	70	72	− 2	− 2·78
1903	49	55	− 6	−10·91	70	73	− 3	− 4·11
1904	49	52	− 3	− 5·77	71	74	− 3	− 4·05
1905	51	50	1	2·00	73	74	− 1	− 1·35
1906	52	49	3	6·12	79	75	4	5·33
1907	54	50	4	8·00	82	76	6	7·89
1908	45	51	− 6	−11·76	74	78	− 4	− 5·13
1909	46	55	− 9	−16·36	76	80	− 4	− 5·00
1910	50	57	− 7	−12·28	80	81	− 1	− 1·23
1911	58	59	− 1	− 1·69	82	82	0	0
1912	78	81	− 3	− 3·70	87	87	0	0
1913	68	126	− 58	−46·03	87	96	− 9	− 9·38
1914	67	219	−152	−69·41	87	110	−23	−20·91
1915	199	318	−119	−37·42	110	126	−16	−12·70
1916	365	376	− 11	− 2·93	139	144	− 5	− 3·47
1917	695	420	275	65·48	179	168	11	6·55
1918	751	434	317	73·04	196	178	18	10·11
1919	490	424	66	15·57	210	182	30	16·48
1920	374	390	− 16	− 4·10	256	181	75	41·44
1921	166	308	−142	−46·10	158	175	−17	− 9·71
1922	130	216	− 86	−39·81	134	167	−33	−19·76
1923	123	165	− 42	−25·45	132	156	−24	−15·38
1924	121	129	− 8	− 6·20	142	137	5	3·65
1925	110	122	− 12	− 9·84	139	132	7	5·30
1926	133	119	14	11·76	129	129	0	0
1927	122	115	7	6·09	124	125	− 1	− 0·80
1928	112	111	1	0·90	122	116	6	5·17
1929	115	108	7	6·48	117	108	9	8·33
1930	93	101	− 8	− 7·92	99	101	− 2	− 1·98
1931	90	95	− 5	− 5·26	85	96	−11	−11·46
1932	88	92	− 4	− 4·35	82	91	− 9	− 9·89
1933	85	90	− 5	− 5·56	81	87	− 6	− 6·90
1934	85	—	—	—	84	—	—	—
1935	88	—	—	—	86	—	—	—
1936	103	—	—	—	90	—	—	—

TABLE IX

Details of Routes, Cargoes and Gross Freight Earned.
(*Summarized in Table H*)

		In Vessels of 3,000 g.t. & over			In Vessels of under 3,000 g.t.		
		No.	Tons	£	No.	Tons	£
	(1) *Coal and Coke Tramp Cargoes Carried by U.K. Vessels in* 1935						
EE	Australia to Singapore ...	2	14,800	6,290			
	Calcutta to Bombay, etc. ...	86	685,334	271,278			
	Durban to Colombo	60	451,167	174,827			
	Canadian Coasting Trade ...	238	1,785,000	357,000			
		386	2,936,301	809,395			
EF	Australia to Java	3	22,200	9,435			
	Durban to Foreign Countries	15	109,758	42,531			
		18	131,958	51,966			
EU	Nil ...						
FE	Antwerp and Rotterdam to Canada	4	24,760	8,666			
	Rotterdam, etc., to I.F.S. ...	—	—	—	12	12,000	3,600
	Germany to I.F.S.	—	—	—	16	31,200	7,410
	Japan to Singapore	14	31,000	7,750			
		18	55,760	16,416	28	43,200	11,010
FF	Japan to Japan and Manila	9	55,800	13,950			
	Ghent, Antwerp, Rotterdam and German Ports to Mediterranean (mostly Italy) ...	113	742,975	278,616			
	Danzig and Gdynia to Mediterranean (mostly Italy) ...	30	212,940	93,161			
	Barentsburg to Murmansk ...	20	127,800	64,000*			
	U.S.A. to Cuba and S. America	21	117,243	46,897			
	China and Japan to China and Japan	11	77,550	21,326			
	French Indo-China to France	18	131,400	119,903			
	S. Russia to U.S.A.	38	238,868	128,392			
	Antwerp and Rotterdam to S. America	16	108,688	44,834			
	Antwerp and Rotterdam to U.S.A.	3	12,177	5,784			
	Antwerp and Rotterdam to Rouen	—	—	—	78	280,410	49,072
	Danzig and Gdynia to Antwerp, Rotterdam and French Channel Ports ...	—	—	—	70	273,000	51,188
	Miscellaneous...	—	—	—	13	27,300	7,508
		279	1,825,441	816,863	161	580,710	107,768
FU	Nil						
UE	Malta, Palestine and Aden ...	19	93,670	36,297	4	10,536	4,478
	Gibraltar	52	377,000	113,100	18	55,080	17,213
	Brit. N. America	198	1,287,000	418,275	9	32,697	11,444
	Colombo, Singapore, etc. ...	13	93,626	51,494			
		282	1,831,296	619,166	31	98,313	33,135
UF	France	26	130,000	48,750	2,313	3,176,398	700,078
	Other Foreign Countries ...	864	5,659,721	2,288,264	1,766	4,115,331	1,032,957
		890	5,789,721	2,337,014	4,079	7,291,732	1,733,035
	Total	1,873	12,590,477	4,650,820	4,299	8,013,955	1,884,948

	No.	Tons	£
All vessels	6,172	20,604,432	6,535,768

* Estimated.

TABLE IX (*continued*)

		In Vessels of 3,000 g.t. & over			In Vessels of under 3,000 g.t.		
		No.	Tons	£	No.	Tons	£
	(2) *Grain* (*including Rice and Soya Beans*)						
EE	Australia to Bombay ...	1	4,519	3,954			
	Other EE	17	118,524	121,487			
		18	123,043	125,441			
EF	Montreal to Cont.	5	39,355	18,366			
	Australia to China and Japan	54	445,500	289,575			
	Rice, Rangoon to Cont. ...	9	71,100	79,988			
	Rice, Rangoon to Gdynia ...	3	20,700	24,840			
	South Africa to Cont. ...	12	90,924	64,783			
	Other EF	18	122,400	67,320			
		101	789,979	544,872			
EU	Montreal, etc., to U.K. ...	70	520,100	208,040			
	N. Pacific to U.K.	29	240,700	210,613			
	S. Australia or Victoria to Mediterranean and U.K. ...	36	275,940	351,824			
	W. Australia to U.K. ...	36	284,976	345,533			
	Sydney, N.S.W., to U.K. ...	28	231,000	277,200			
	South Africa to U.K. ...	28	212,156	151,161			
		227	1,764,872	1,544,371			
FE	River Plate to Canada ...	14	104,006	92,305			
	River Plate to other Empire Ports	20	110,000	115,500			
	Saigon and Kohsichang to Madras	9	50,337	27,685			
	Other FE	3	24,000	11,400			
		46	288,343	246,890			
FF	Bahia Blanca to Mediterranean	6	46,422	35,977			
	Bahia Blanca to Cont. ...	51	402,951	297,176			
	Buenos Ayres or La Plata to Mediterranean	10	68,290	61,034			
	Buenos Ayres or La Plata to Cont.	137	1,046,817	846,177			
	U.S.A. Northern Range to Cont.	7	53,697	25,953			
	Saigon or Kohsichang to Cont.	26	201,500	251,875			
	River Plate to other Foreign Ports	25	190,825	157,431			
	Saigon and Kohsichang to Shanghai	10	77,500	25,188			
	S. Russia to Cont.	7	57,407	27,986			
	Constanza, Varna and Bourgas to Cont.	8	38,632	21,248			
	Russian Black Sea to Vladivostock	15	115,560	98,226			
	River Plate to U.S.A. ...	65	457,730	406,235			
	Saigon and Kohsichang to Cuba	14	107,800	132,055			
	Soya Beans, Dalny to Cont.	24	195,000	219,375			
	Morocco to France and China Coasting	—	—	—	12	24,720	12,360
	Other FF	11	81,400	67,155			
		416	3,141,531	2,673,091			
FU	Bahia Blanca to U.K. ...	27	212,355	156,612			
	Buenos Ayres or La Plata to U.K.	205	1,566,405	1,266,177			
	Rosario or San Lorenzo to U.K.	109	710,898	595,377			
	Sante Fe to U.K.	8	50,560	42,344			
	S. Russia to U.K.	32	242,240	124,148			
	Soya Beans, Dalny to U.K.	5	40,625	45,703			
	Cont. to U.K.	—	—	—	404	276,336	73,690
	Other FU	6	47,100	56,520			
		392	2,870,183	2,286,881			
	Total	1,200	8,977,951	7,421,546	416	301,056	86,050

	No.	Tons	£
All vessels	1,616	9,279,007	7,507,596

TABLE IX (*continued*)

		In Vessels of 3,000 g.t. & over			In Vessels of under 3,000 g.t.		
		No.	Tons	£	No.	Tons	£
	(3) *Timber and Grain*						
EU	British Columbia to U.K. ...	105	892,500	814,406			
	(4) *Timber*						
EE	Miscellaneous EE	56	408,800	613,200			
EF	Miscellaneous EF	61	415,300	667,950			
EU	W. Africa to Hamburg and London	—	—	—	4	5,916	8,874
FE	Miscellaneous FE	7	51,100	76,650			
FF	White Sea to Holland ...	21	122,913	74,674			
	Russia to Cont.	—	—	—	24	84,000	51,660
	Miscellaneous FF, omitting Russia	17	124,100	186,150			
		38	247,013	260,824			
FU	Russia (Igarka) to London ...	12	67,600	85,683			
	Russia (Archangel) to Tyne	22	126,720	60,048			
	S. Finland to E. Coast, U.K.	—	—	—	136	436,800	153,224
	Baltic Ports (Sweden, Norway and Finland) to U.K.	—	—	—	63	149,100	71,568
	France and Portugal to U.K.	—	—	—	65	137,995	46,573
	Russia (Leningrad) to E. Coast, U.K.	—	—	—	70	257,810	161,146
	Russia (Kara Sea) to London	—	—	—	15	48,650	63,123
		34	194,320	145,731	349	1,030,355	495,634
UE	Nil						
UF	Nil						
	Total	196	1,346,533	1,764,355	377	1,120,271	536,168

	No.	Tons	£
All vessels	573	2,466,804	2,320,523

		In Vessels of 3,000 g.t. & over			In Vessels of under 3,000 g.t.		
	(5) *Timber and Other Cargoes* (*not Grain*)						
EE	Miscellaneous EE	3	20,088	10,181			
EF	Miscellaneous EF	6	35,154	18,341			
FE	Miscellaneous FE	1	5,022	2,620			
FU	Miscellaneous FU	7	40,176	20,962			
FF	Miscellaneous FF	2	10,044	5,240			
	Total	19	110,484	57,644			

TABLE IX (*continued*)

		In Vessels of 3,000 g.t. & over			In Vessels of under 3,000 g.t.		
		No.	Tons	£	No.	Tons	£
			(6) *Ore*				
EE	Gold Coast (Takoradi) to Montreal	3	24,600	15,683			
	Gold Coast (Takoradi) to other Ports in Canada ...	2	16,250	10,359			
		5	40,850	26,042			
EF	S. Australia (Whyalla) to Japan	35	269,500	121,275			
	Gold Coast (Takoradi) to U.S.A.	16	130,000	82,875			
	Vizagapatam to Dunkirk, etc.	16	121,600	106,400			
		67	521,100	310,550			
EU	Vizagapatam to Workington	14	113,036	98,907			
FE	Nil						
FF	Algiers and Tunis to Rotterdam	13	91,286	20,539			
	Marmagoa to Antwerp ...	7	52,857	48,893			
	Spanish Morocco to Rotterdam	12	63,000	17,325			
	Spain (Huelva) to Antwerp, Rotterdam, Hamburg ...	12	65,400	19,620			
	Black Sea to U.S.A.	34	289,000	180,625			
	Spain (Huelva) to U.S.A. ...	22	175,120	107,261			
	Russia (Leningrad) to U.S.A., Pacific	7	57,680	31,724			
	Miscellaneous FF	16	123,200	132,440	62	210,800	59,727
		123	917,513	558,427			
FU	Tunis (La Goulette) to U.K.	47	326,650	100,037			
	Spain (Almeria) to Middlesbrough	31	212,226	64,994			
	Algeria to Middlesbrough ...	49	325,850	95,718			
	W. Africa (Pepel) to Garston and Glasgow	36	219,600	105,225			
	Spanish Morocco to U.K. ...	20	105,400	31,620			
	N. Africa to Middlesbrough...	—	—	—	12	47,232	13,874
	Delfzyl to U.K. (Bog Ore) ...	—	—	—	49	51,450	13,184
	Spain (Bilbao) to Middlesbrough	—	—	—	200	530,000	139,125
	Miscellaneous FU	6	46,800	30,420			
		189	1,236,526	428,014	261	628,682	166,183
UE	Nil						
UF	Nil						
	Total	398	2,829,055	1,421,940	323	839,482	225,910

	No.	Tons	£
All vessels	721	3,668,537	1,647,850

(7) *Sulphur and Zinc Concentrates*

		In Vessels of 3,000 g.t. & over			In Vessels of under 3,000 g.t.		
		No.	Tons	£	No.	Tons	£
FE	Italy and U.S.A. to Australia and Capetown	5	31,500	27,563			
EF	Canada to Cont. and Cyprus to U.S.A.	2	12,600	11,025			
	Total	7	44,100	38,588			

TABLE IX (*continued*)

(8) *Fertilizers* (*Phosphate, etc., Nitrate*)

		In Vessels of 3,000 g.t. & over			In Vessels of under 3,000 g.t.		
		No.	Tons	£	No.	Tons	£
EE	Phosphate. Nauru, Ocean Island and Christmas Island to Australia and New Zealand	68	561,000	350,625			
EF	Canada to Spain	3	14,706	8,456			
	Phosphate. Christmas Island to Sweden	2	10,910	14,115			
		5	25,616	22,571			
EU	Nil						
FE	Phosphate, Cont. and Casablanca to Cape Town and Australia	20	155,220	65,969			
FF	Phosphate. Casablanca and Egypt to Japan	25	208,175	122,303			
	Phosphate. Miscellaneous FF	24	125,400	72,105			
	Nitrate. Chile to Cont. and Egypt	30	247,500	259,875			
	Nitrate. Chile to U.S.A. and Japan	13	96,850	96,850			
	Cont. to Cont.	—	—	—	40	80,000	28,000
		92	677,925	551,133			
FU	Nitrate. Chile to U.K. ...	8	43,680	56,784			
	Sfax, etc., to U.K.	8	39,600	17,820			
	Tunis, Bona and Casablanca to U.K.	—	—	—	28	89,600	34,720
	Cont. to U.K.	—	—	—	118	67,260	20,178
		16	83,280	74,604	146	156,860	54,898
UE	Middlesbrough to S. Africa and Australia	6	30,378	26,581			
UF	U.K. to Cont.	—	—	—	41	50,430	7,880
	Total	207	1,533,419	1,091,483	227	287,290	90,778

	No.	Tons.	£
All vessels	434	1,820,709	1,182,261

TABLE IX (*continued*)

		In Vessels of 3,000 g.t. & over			In Vessels of under 3,000 g.t.		
		No.	Tons	£	No.	Tons	£
	(9) *Sugar*						
EE	Australia and Fiji to Canada	3	24,069	31,591			
	Brit. W. Indies to Canada ...	9	64,800	38,880			
	Mauritius to Montreal ...	3	21,600	21,600			
		15	110,469	92,071			
EF	Brit. W. Indies to Cont. ...	1	5,250	3,117			
	Brit. W. Indies to U.S.A. ..	1	4,961	2,977			
		2	10,211	6,094			
EU	Mauritius to U.K.	18	143,190	135,136			
	Australia to U.K.	16	132,512	177,235			
	Fiji to U.K.	10	77,050	91,497			
	Durban to U.K.	1	8,393	6,714			
		45	361,145	410,582			
FE	Java to New Zealand ...	9	70,785	41,586			
	Cuba to New Zealand ...	1	7,867	6,884			
	Java to India	8	54,568	30,012			
		18	133,220	78,482			
FF	Cuba and non-Brit. W. Indies to Cont.	19	108,699	67,937			
	Cuba and non-Brit. W. Indies to U.S.A.	15	79,620	41,801			
	Java to Cont.	4	31,020	35,285			
	Miscellaneous FF	10	71,420	67,849	5	2,555	316
		48	290,759	212,872			
FU	Cuba to U.K.	47	348,740	217,963			
	San Domingo to U.K. ...	27	159,138	99,461			
	Java to U.K.	1	7,737	8,704			
	Peru to U.K.	1	3,550	3,506			
	Cont. to U.K.	—	—	—	3	1,533	189
		76	519,165	329,634			
UF	U.K. to Cont.	—	—	—	10	5,110	631
	Total	204	1,424,969	1,129,735	18	9,198	1,136

	No.	Tons	£
All vessels	222	1,434,167	1,130,871

TABLE IX (*continued*)

		In Vessels of 3,000 g.t. & over			In Vessels of under 3,000 g.t.		
		No.	Tons	£	No.	Tons	£
	(10) *Iron and Steel and Scrap*						
EE	Miscellaneous EE	4	31,188	22,042			
EF	British Columbia to Japan, etc.	5	47,232	33,062			
EU	Sydney, C.B., to U.K. ..	5	41,030	11,283			
FF	U.S.A. to Japan	42	333,018	224,787			
	U.S.A. to Italy	11	72,446	57,957			
	Russia to Japan	19	143,450	136,278			
	Russia to S. America ...	1	7,872	5,510			
	Cont. to Cont.	—	—	—	7	5,474	2,053
		73	556,786	424,532			
FU	U.S.A. to U.K.	12	71,736	41,218			
	Belgium and France to U.K.	—	—	—	199	159,200	35,820
UE	Nil						
UF	U.K. to Cont. and Mediterranean	—	—	—	56	47,992	15,597
	Total	99	748,272	532,167	262	212,666	53,470
	All vessels			No. 361	Tons 960,938	£ 585,637	
	(11) *Salt*						
EE	Aden to India	58	473,103	236,551			
EU	Nil						
EF	Nil						
FE	Egypt to Penang	4	27,830	13,915			
FF	Egypt to Japan	24	194,807	97,404			
FU	Nil						
UE	Nil						
UF	Nil						
	Total	86	695,740	347,870			
	(12) *Paper*						
EF	Canada to U.S.A.	11	45,265	19,238			
EU	Canada to U.K.	19	95,190	67,823			
UF	U.K. to Belgium	—	—	—	5	900	225
	Total	30	140,455	87,061			
	All vessels			No. 35	Tons 141,355	£ 87,286	

TABLE IX (*continued*)

		In Vessels of 3,000 g.t. & over			In Vessels of under 3,000 g.t.		
		No.	Tons	£	No.	Tons	£
	(13) *Strawboards*						
FU	Delfzyl (Holland) to U.K. ...	—	—	—	40	32,000	8,800
	(14) *Esparto*						
FU	Algiers to U.K.	7	16,555	11,175	87	148,248	109,333
	All vessels	No. 94	Tons 164,803	£ 120,508			
	(15) *Bauxite*						
FU	Toulon to Burntisland ...	17	88,672	28,818			
	France to Scotland	—	—	—	18	64,692	22,642
	All vessels	No. 35	Tons 153,364	£ 51,460			
	(16) *Sand, Cement, etc.*						
FU	Cont. to U.K.	—	—	—	299	218,270	35,469
	(17) *China Clay*						
UF	U.K. to U.S.A.	10	48,390	32,663			
	U.K. to Cont.	—	—	—	55	29,700	10,395
	All vessels	No. 65	Tons 78,090	£ 43,058			
	(18) *Pitch and Asphalt*						
UF	U.K. to Cont.	—	—	—	144	169,200	33,840
	(19) *Cork*						
FU	Spain to U.K.	—	—	—	16	12,768	10,853
	(20) *West African Produce*						
EF	W. Africa to Cont.	20	122,560	104,176			
EU	W. Africa to U.K.	20	122,560	104,176			
	Total	40	245,120	208,352			

TABLE IX (*continued*)

	In Vessels of 3,000 g.t. & over			In Vessels of under 3,000 g.t.		
	No.	Tons	£	No.	Tons	£
	(21) *General and Mixed*					
EE	21	118,650	57,646			
EF	19	123,500	138,938			
EU	25	157,500	153,562			
FE	45	276,750	314,803			
FF	100	543,000	475,125	22	16,368	6,547
FU	59	309,750	371,700	294	288,120	79,233
UE	34	163,880	127,007			
UF	11	66,176	34,742	52	26,000	5,850
Total	314	1,759,206	1,673,523	368	330,488	91,630

	No.	Tons	£
All vessels	682	2,089,694	1,765,153

GRAND TOTAL ...	4,812	33,491,898	21,312,146	6,954	11,790,184	3,221,647

	No.	Tons	£
All vessels	**11,766**	**45,282,082**	**24,533,793**

TABLE X

Routes Used as Material for New Monthly Index Number

Group 1 (*a*). *Outward Coal Freights from the U.K.*

	Route	Weight £ (000)	Freight Rates 1935	
	(Ships of under 3,000 gross tons.)		*s.*	*d.*
1.	Cardiff or Newport to Algiers	108	7	7
2.	„ Bordeaux	18	4	5
3.	„ Brest	10	4	4½
4.	„ Chantenay	5	4	3½
5.	„ Cherbourg	3	4	9¼
6.	„ Dieppe	3	3	11
7.	„ Gibraltar	17	5	11¾
8.	„ Havre	12	3	10½
9.	„ La Rochelle	22	4	4½
10.	„ Malta	4	7	7¾
11.	„ Nantes	5	4	6½
12.	„ Oporto	257	7	5¾
13.	„ Piraeus	13	9	2
14.	„ Rouen	38	4	2¾
15.	„ St. Brieue	6	5	1¾
16.	„ St. Malo	3	4	7¼
17.	„ St. Nazaire	4	3	11¾
18.	Llanelly to Havre	4	4	9¾
19.	„ Rouen	44	5	7¼
20.	Port Talbot to Rouen	50	5	0¾
21.	Swansea to Amsterdam	46	5	6
22.	„ Bordeaux	31	4	9
23.	„ Brest	8	3	7½
24.	„ Montreal or Quebec	11	7	0
25.	„ Rouen	58	5	8½
26.	Firth of Forth to Bordeaux	24	5	6½
27.	„ „ Copenhagen	148	4	4¼
28.	„ „ Helsingfors	22	3	9¼
29.	„ „ Rouen	5	5	1½
30.	Tyne, Blyth or Dunston to Boulogne	8	4	5½
31.	„ „ „ Cherbourg	4	4	6½
32.	„ „ „ Dieppe	15	3	5¾
33.	„ „ „ Elbe Port	158	4	0¼
34.	„ „ „ Genoa	49	7	2½
35.	„ „ „ Havre	23	4	7½
36.	„ „ „ Rouen	91	4	4¾

Total weight 1,885
Add 231 for cargoes other than coal carried in ships of under 3,000 gross tons (lines 12 to 19 of Table M in text)

2,116

TABLE X (*continued*)

Group 1 (*b*). *Coal*

	Route	Weight £ (000)	Freight Rates 1935
	(Ships of 3,000 gross tons and over.)		*s. d.*
1.	Cardiff or Newport to Malta	36	7 7¾
2.	,, ,, ,, Gibraltar	113	5 11¾
3.	Swansea to Montreal or Quebec	418	7 0
4.	Cardiff or Newport to River Plate *	923	8 10¾
5.	,, ,, ,, Las Palmas	34	7 1¼
6.	Swansea to Northern States	61	6 8
7.	Cardiff or Newport to Port Said	466	7 6¼
8.	,, ,, ,, Marseilles	49	7 6
9.	Tyne, Blyth or Dunston to Genoa, Savona, etc. ...	455	7 2½
10.	,, ,, ,, ,, Oran	259	7 4¼
11.	Cardiff or Newport to Lisbon	29	6 11¾
12.	Antwerp to Genoa, Savona, etc.	279	8 7¾
13.	Dantzig, Gdynia to Genoa, Savona, etc.	93	9 3½
14.	Antwerp or Rotterdam to River Plate *	45	9 0
15.	Russia, Black Sea to Northern States	128	11 5¼
16.	Durban to Colombo	217	6 9¾
17.	Calcutta to Bombay	271	5·14 Rs.
18.	Port Redon or Haiphong to France	120	19 5½

Total weight for coal in ships of 3,000 gross tons and over—4,651 (line 1 of Table M)

Group 2. *Grain Cargoes*

	Route	Weight £ (000)	Freight Rates 1935
1.	Albany to U.K./Cont. (per qr.)	26	1 8
2.	Montreal to U.K./Cont. (per qr.)	18	1 9¼
3.	Bahia Blanca to U.K./Cont.	454	14 4¾
4.	Buenos Ayres or La Plata to U.K./Cont.	2,112	14 7¾
5.	Rosario to U.K./Cont.	595	16 6
6.	Santa Fe to U.K./Cont.	42	17 8½
7.	North Pacific to U.K./Cont. (F.I.O.)	211	19 0
8.	Burma to Cont.	105	22 6¼
9.	Delhi to Cont.	265	20 4¾
10.	Saigon to Mediterranean U.K./Cont.	67	23 8
11.	South Australia or Victoria to U.K./Cont. (Bags) ...	352	26 6
12.	West Australia to U.K./Cont. (Bags)	346	26 0½
13.	Sydney N.S.W. to U.K./Cont.	277	23 1½
14.	South Africa. Cape Town, Durban to U.K./Cont. ...	216	13 11¼
15.	Roumania. Constantza, Varna, Bourgas to Antwerp or Rotterdam	21	12 0
16.	South Russia, Black Sea to Vladivostock	98	16 9
17.	Black Sea to U.K./Cont.	152	10 0½

Total weight	7,508	
Add Timber and Grain	814	(line 3 of Table M)
West African Produce	208	(line 20 of Table M)
General and Mixed	1,765	(line 21 of Table M)
Timber and other cargoes ...	58	(line 5 of Table M)
Timber not from Russia not to U.K.	1,544	(part of line 4 of Table M)
Other cargoes in vessels of 3,000 gross tons and over	508	(lines 11 to 19 of Table M)
	12,406	

* Lower Ports.

TABLE X (*continued*)

Group 3. *Timber*

Route		Weight £ (000)	Freight Rates 1935 s.	d.
(Ships of 3,000 gross tons and over.)				
1. White Sea Ports to Holland (Stds.)		75	40	5¼
Total weight for Timber in vessels of over 3,000 gross tons, other than part assimilated with Grain	221			
(Ships of under 3,000 gross tons.)				
2. Finland (Lower Zone) to East Coast U.K. (Fms.)		153	29	2¼
3. Leningrad to Holland (Stds.)		52	32	0
4. „ U.K./Cont. (Stds.)		161	32	9¾
Total weight for Timber in vessels of under 3,000 gross tons	556			
Total weight	777			

Group 4. *Ore*

Route		Weight £ (000)	s.	d.
1. Algiers to Middlesbrough		96	6	3½
2. Bilbao to Middlesbrough		139	4	8½
3. Bona to Rotterdam or Vlaardingen		21	4	5¾
4. Huelva to Antwerp, Ghent		20	7	6½
5. „ Northern States		107	11	2½
6. La Goulette to Workington		100	7	0
7. Melilla to Rotterdam		17	5	0½
8. West Africa, Pepel to Glasgow		105	8	9½
9. Black Sea, Odessa to Tacoma		181	13	3
10. India, Marmagoa to Cont. (Manganese)		49	17	6½
11. Vizagapatam to Cont. (Manganese)		106	15	10
12. „ „ Workington (Manganese)		99	18	8¼
Total weight	1,648			
Add Sulphur and Zinc Concentrates...	38	(line 7 of Table M)		
	1,686			

Group 5. *Fertilizers*

Route	Weight £ (000)	s.	d.
1. Chile to Cont. (Nitrate)	260	19	4¾
2. Sfax or Susa to East Coast U.K. (Phosphate) ...	53	8	1½

Total weight 1,182.

Group 6. *Sugar*

Route	Weight £ (000)	s.	d.
1. Cuba to Marseilles	68	13	9¾
2. „ U.K.	218	13	2
3. Santa Domingo to U.K./Cont.	99	12	5¾
4. Mauritius to U.K.	135	—	
5. Queensland to U.K.	177	28	9

Total weight 1,131.

Group 7. *Iron and Steel and Scrap*

Route	Weight £ (000)	s.	d.
1. Northern Range to Japan	225	13	3¾
2. „ „ „ West Italy	58	$4·31	
3. „ „ „ U.K.	41	12	0¾

Total weight 585.

TOTAL WEIGHT ALL GROUPS **24,534.**

DISCUSSION ON DR. ISSERLIS'S PAPER

MR. H. W. MACROSTY: The mover of a vote of thanks always begins by expressing the pleasure which this function gives him, but in my case there are two personal reasons for the emotion. When I became an Honorary Secretary of this Society nine years ago, I found that a paper by Dr. Isserlis—a paper on British Shipping—had been on the stocks since 1921 or so, and I made it my first duty to extract that paper. Dr. Isserlis renewed his promises, and for two or three years his name appeared on the " card "—fruitlessly. My hope faded, but at last it has fructified abundantly, beyond what I had asked or hoped. My second reason is my gratification at his commendation of the early work which I did in constructing, on admittedly imperfect data, an index of shipping. Dr. Isserlis is concerned with four main themes. The first, in section 3, is the contribution of shipping to the settlement of our balance of payments on international account. When we first began to handle this problem at the Board of Trade after the War, we had to supplement the information obtained from the *Daily Freight Register* and the Trade Accounts with particulars privately obtained from friendly shipowners and shipbrokers. Later we got in touch with Dr. Isserlis and compared our results with his. Both, at that time, were largely estimated, but more recently he has been able to restrict the bounds of estimate and enlarge those of ascertained fact by the results of the two enquiries which he has described. It is a matter for much satisfaction that these new investigations show that the earlier calculations, if not rigidly accurate, were on the right lines and probably presented a reasonable picture. We are all immensely indebted to the shipowners and the Chamber of Shipping for the work they have done, and I am sure that this Society would be gratified if they would repeat those enquiries every three years, as a permanent contribution to our knowledge. Secondly, I would like them to give us also the tonnage of goods carried on the principal trade routes by British ships, but failing that I would draw your attention to the great importance of Table I on p. 96. In section 4 Dr. Isserlis has performed an enormous task in giving us chain-indices for freights on all important commodities and routes for 68 years, a task which justifies the epithet " monumental." Future investigators will be saved much labour. The fragmentary nature of some of the quotations must to some extent distort the indices, and it is probable that those for the earlier years, when only highest and lowest freights were available, should be taken as indications rather than measures. It should also be remembered that the whole series cannot safely be taken as the measure of liner and tramp shipping together, but in the recent years of the subsidy certain liner and tramp rates were definitely linked together. The disappearance of some quotations and the emergence of others give some useful indications of shifts of trade. I do not think the comparison of tramp freights and wholesale prices is useful. Both are similarly influenced by good trade and bad trade, but no causal connection appears to be traceable in their movements. It would be interesting if a time-lag could be identified, but for that a more detailed table than Table VIII would be required.

For section 5 on the employment of tramp shipping, I have nothing but praise; the information is new and valuable. Lastly, I come to section 6 and Dr. Isserlis's most important contribution, his new weighted index number of tramp shipping freights. I do not propose to examine it in detail. I leave to my seconder, if he so choose, that constructive criticism which it is the privilege of the mover and seconder to dispense freely and abundantly. I would, however, point out that the comparison of future contracts for charters and "futures" in the commodity markets on page 88 is, to me, somewhat mistaken. I believe it is admitted that spot prices of cotton and "futures" are closely connected, and similarly it seems to me that there must be a connection between the present freights and the freights contracted for a month or more ahead, and this seems to be supported by the close correspondence of the averages of the subsidy rates and the quoted rates. But I agree that there is little utility in comparing the "futures" market and the freight market. The sufficiency of the quotations taken by Dr. Isserlis for his calculations is a matter for the practical people engaged in the running of ships. Personally, I am ready to accept the new index number, and I hope Dr. Isserlis will not feel moved to reply in the terms of Carlyle's reported comment on the declaration of a lady that she was prepared to "accept the universe."

I feel admiration for the way in which Dr. Isserlis has embodied in this paper his conceptions of the index number for shipping, and gratitude to him and his assistants for their great labours in assembling the data and making the necessary calculations. I am equally certain that all those here present share these sentiments, and it is with confidence that I propose that this meeting accord to Dr. Isserlis its warmest thanks for his valuable paper.

MR. LEAK: I am very glad to have the opportunity of seconding this vote of thanks to Dr. Isserlis for his most interesting paper. As a representative of the Board of Trade, I should like to express our thanks to him, and through him to the Chamber of Shipping and the shipowners, for their response to the request made to them to provide accurate data regarding the earnings of British shipping abroad. That, I know, has involved Dr. Isserlis in a great amount of work, some of the results of which are given in this paper. The response on the second occasion was so much better than on the first, that I hope it will be continued when we ask Dr. Isserlis to repeat the enquiry.

The records of the Tramp Shipping Subsidy Committee have provided Dr. Isserlis with some valuable facts, which he has used to give us a very much needed new index number of shipping freights. I am glad he was unable to obtain the data to construct the second half of Irving Fisher's ideal formula. As that formula imports into the index a factor depending on changing quantities of goods carried, I regard as a much more accurate measure of rates of freight the one which Dr. Isserlis has been obliged to make use of, viz. an index number showing changes in the amount earned in carrying a fixed basket of goods. The contents of that basket change from time to time, and I do not know whether 1935 was entirely normal. Coal exports, for example, were lower in that year than in any year except 1936, and coal is likely to be under-weighted in the index by using the 1935 data only. There is nothing in the paper to indicate whether Dr. Isserlis has considered this aspect of the matter, but I think it merits his attention. I would suggest also that an examination of the contents of the basket of goods should be made from time to time.

The new Board of Trade Shipping Statistics, which, as Dr. Isserlis mentions on p. 86, have been published for 1936, may provide data on which a revision of the quantitative base of the index may be made with greater accuracy than has been possible in the past. The statistics show that for 1936 the proportion of coal cargoes carried in British ships, corresponding with the 38 per cent. derived from Table N, was about 45 per cent., which serves to reinforce my suggestion that coal is probably under-weighted in the new index. Some amendments of the text below Table N are necessary, as the Irish Free State, an important market for coal, is omitted from the table, presumably for the reason that voyages to the Irish Free State were not eligible for subsidy.

The weighting of the index is set out on pp. 90 foll. It seems to me that the new index is likely to suffer from one of the defects of the old one—namely, an over-weighting of grain freights. It will be seen that the genuine figure for grain cargoes (£7,508,000) is pushed up by a number of additions to £12,406,000. Is there, for example, any real ground for believing that freights on West African produce, or on general and mixed cargoes, correspond at all closely with fluctuations in grain cargo freights, especially when the latter are, as they have been recently, subject to minimum freight schemes for the benefit of the shipowner? Also, in view of the control of grain freights dating from February 14th, 1935, is it not possible that the average for grain freights in 1935 may have been high in relation to freights on other commodities? If so, that would mean that grain freights are further over-weighted in the index. I notice that no addition is made to the weight for sugar. Is that trade so unimportant that it does not exert any influence upon the freight rate on general cargoes? As a basis for the index would it not perhaps be better to take essentially the cargoes for which freight rates are available, and to leave the miscellaneous remainder out of account, without making assumptions as to how the miscellaneous freight rates move? Having got an approximate weighting in this way, I would suggest that the general considerations I have mentioned might be taken into account, and it would then be possible to arrive at a simple index number based upon a weight of 50 or 100, instead of using proportions of 24,534. Besides, it would have the advantage of simplifying the arithmetic.

The existing Chamber of Shipping Index Number is compiled by the geometric average, and Dr. Isserlis has abandoned this in favour of the arithmetic average. He has not, however, favoured us with a discussion of the relative value of the two methods as applied to an index number of shipping freights. The geometric average is always lower than the arithmetic, and the advantages of either method, as it seems to me, depend upon what happens when freights on an individual route are either abnormally high or abnormally low. If a high freight rate is generally the result of a small supply of shipping on that route, the geometric average would be better than the arithmetic, as it is for wholesale price index numbers, since prices tend to rise if supplies are short, and therefore the higher-priced goods should exercise a smaller influence on the general index. If, on the other hand, a high freight rate normally results from a larger volume of shipping being required to carry cargo on a certain route, then the arithmetic average would be more appropriate. I do not know which of these two is likely to be more correct, or whether there is some third alternative: perhaps some of those present who are intimately acquainted with the subject may give us some guidance on that point.

Dr. Isserlis referred to the problem of the dropping out of quotations. It certainly is a problem, one perhaps not capable of an ideal solution. *Lloyds' List*, I believe, take the advice of a market expert as to the probable rate if no fixture is recorded. I do not know what the *Economist* does. In price index numbers it is, I think, the general practice, when a quotation drops out, to regard the movement as similar to that of goods of a similar character. That, at any rate, is what we do at the Board of Trade. Of the various solutions, I like least that adopted in the new index, viz., the complete dropping from the index of quotations for which no data have been published, though it is quite possible—except perhaps for timber in the winter months—that fixtures may have been arranged. This method is similar to that adopted in the existing Chamber of Shipping Index, and the irregularities caused by it may be illustrated by what happened to that index between January and March 1936, when the index fell by 7 per cent. between January and February, and rose by 5 per cent. in March. The *Economist* and *Lloyds' List* index numbers agreed that there was a downward movement in freight continuously over those three months. The incorrect movement of the Chamber of Shipping Index was due to the dropping out in February of the quotation from Northern Range to West Italy, which happened to be very much higher than the general average.

In Table O on p. 93, it will be seen that there was no quotation for fertilizers last July. In the months before and after, the index number for this group was lower than for the general index. The assumption underlying the method of dealing with the missing quotation for July is that the index for fertilizers in July was the same as the general index—that is to say, that the index for fertilizers rose from 177 to 185, and then dropped back to 172. Is Dr. Isserlis convinced of the accuracy of that assumption? I do suggest that he should revise the method of dealing with missing quotations in all the cases where there are not a sufficient number of quotations in the group to make it really representative. In the fertilizer group there are two quotations, for nitrate and phosphates. If the quotation for nitrate drops out, is the movement of the rate for phosphate, which had an actual weight of £53,000 in 1935, to be allowed to influence the index to the extent of £1,182,000 or 5 per cent., when its relative importance was 0·02 per cent?

If I have been rather critical in my remarks, it is because I see in the construction of a new index number a golden opportunity, which is not likely to occur again for a number of years, for getting an index number of shipping freights upon which everyone may rely with more confidence than they have felt they could repose in any of the existing index numbers. I think the index can be improved considerably, and I hope it will be before it is finally adopted. To express that hope does not mean that I do not appreciate to the full the work which Dr. Isserlis has done in compiling this index number and presenting it and other interesting data concerning shipping for our consideration this evening. I have much pleasure in seconding the vote of thanks.

MR. E. H. WATTS said he would like, on behalf of the Tramp Shipping Administrative Committee, to express appreciation of the work Dr. Isserlis had done. However, if Dr. Isserlis had been of help to the Committee, he thought the Committee had been rather good for Dr. Isserlis, as when he first started he had been apt to consider statistics as an exact science. From his own point of view, Mr. Watts regarded statistics purely as an aid to commerce, in the same way that executive officers of merchantmen should regard the Echometer Sounding Machine and Directional Wireless as aids to, and not substitutes for, navigation. Indeed, his firm had on one occasion lost a vessel for the very reason that a captain took a directional wireless bearing at its face value, and, the bearing being wrong, placed himself ashore and lost his ship. In the same way, misleading statistics, if taken by the uninitiated at their nominal value, might very well wreck an industry. He gave it as his considered opinion that if it had not been for the erroneous official statistics issued by the Board of Trade during the previous eighty years—which had led the public to believe that all was well with the Merchant Service—the tramp-shipping industry would have received the subsidy at least eighteen months before it did; and many ships which were sold and the seamen who were thereby thrown out of work would have been retained, to the advantage of this country.

Mr. Watts then dealt with a number of the misleading bases of calculations for official statistics indulged in by the Board of Trade. The result of all these "commercial" inaccuracies was that the President of the Board of Trade had been able to say in the House of Commons that British merchant ships carried 90 per cent. of Empire trade, 60 per cent. of the trade between one Empire port and foreign ports and 25 per cent. of the world's trade between two foreign ports. Actually, the trade carried by British ships between two foreign ports was less than 10 per cent., while foreigners carried a great deal more than this amount between ports either within the British Empire or where one terminal was British, and still more important, in many cases the cargoes were British purchases.

If statistics were published, they should have some relative value to the conditions of an industry, because in deciding upon a policy, it was essential to know how big a " broadside " the shipping services presented to the foreigner in exchange for the " broadside " which the foreigner might present to British legislative action. He deprecated the fact that although at one period in 1936 the Board of Trade had obtained accurate figures of actual cargoes carried by actual flags from actual destinations, the *Board of Trade Journal* still persisted in publishing, quarter by quarter, the old misleading statistics.

Finally, Mr. Watts gave it as his opinion that statistics should be designed :—

(1) As a guide to the prosperity of an industry ;
(2) In an industry which was not thriving, as a pointer to how prosperity might be regained.

It seemed to him that any statistics which were mathematically correct but did not conform to these two principles, were not only definitely dangerous to an industry, but most misleading to the general public, and could cause untold harm before public opinion could be induced to abandon them and appreciate the true facts.

MR. E. A. V. ANGIER thanked the Society for the privilege of being present to listen to the discussion on Dr. Isserlis's paper. He much regretted that he was unable to hear him read it, but he had studied it with attention and very much interest, particularly that part which related to the particulars derived from the applications for subsidy. These obviously provided accurate information, hitherto unobtainable, of the employment of the bulk of British tramp ships in a typical period. One wondered whether it would be impossible to arrange for the remission of the 6*d.* stamp duty on a charter party in consideration of the broker or owner depositing with the Board of Trade a copy certified by a Notary Public or a member of the Institute of Chartered Shipbrokers. The Board of Trade receipt for this copy could be attached to the original charter party in lieu of the stamp. An enormous amount of information would thus be acquired, both of voyage and time charter rates, which could profitably be digested by the Board of Trade, assisted, if necessary, by the Chamber of Shipping.

As Dr. Isserlis was forced by present circumstances to forage for information, Mr. Angier admired him—in the strict sense—for extracting so much from the publications of his (the speaker's) family, as a miner might admire the chemist who produced all kinds of beautiful and useful commodities from that which the miner worked out as a lump of coal.

Dr. Isserlis had remarked on the difficulty of comparing freights of 1869 with those of to-day owing to the changes in the types of ships, main routes and nature of cargoes. Cargoes had changed less than the ships and the quarters from which the cargoes came, but there had been many and serious changes in the method of reckoning the rate of freight. For example, though a " Mediterranean Scale," with wheat as the standard, was drafted in 1863, it was little used, and up to 1889 freights from Black Sea ports were paid per London

"Baltic Scale" with clean hemp as the basis but tallow as the standard. A rate reported at, say, 20*s*. per ton tallow meant about 14*s*. 4½*d*. per ton wheat or about 16*s*. 4*d*. per ton barley.

In 1890 a "new charter" was agreed by merchants and shipowners, and thereafter, until the War, freight was paid "per unit," the unit for wheat being 2,240 lbs. and for barley 2,050 lbs. Since the Russian Government had done the chartering the rate had been paid per ton of 2,240 lbs. of any grain not lighter than barley. Similar changes had taken place in many other trades.

It was perhaps presumptuous of one who was on the classical side at school, and even there rarely got more than $\gamma +$ for his mathematical efforts, to criticize the productions of eminent statisticians. However, the fact that his family had been accumulating figures about freights for about a hundred years might serve as an excuse for his daring. The Angiers had never been able to convince themselves that there was any satisfactory way of ascertaining average rates of freight which could be applied universally. Most outward coal freights treated by the method used by Dr. Isserlis would yield results approximating the truth, but almost no homeward freights. It had seemed to them (and *pace* Dr. Isserlis, they were not singular among denizens of the Baltic in holding this view) that to arrive at the average rate for, say, January from the River Plate by lumping together all the fixtures reported in that month, whether for loading in January or at any other date, would result in a figure which meant really nothing. One could suggest other ways, *e.g.* that the rate for January should be based on the freights of all ships loaded in that month, whenever fixed, which would be less illusory, but still open to serious objection. For in almost all homeward trades nowadays, the charter party gave the charterers various options, both as to the loading and discharging, at various rates, so that even if all fixtures were reported fully and truly, one could not tell which option would be used and therefore what rate would be earned. In the River Plate fixtures were often done to one or more of a range of ports at different rates, and the variance between the highest and lowest might well be 2*s*. 6*d*.—say, on to-day's minimum schedule rate, 10 per cent. or more. This had always seemed to him completely to prevent the attainment of any sound basis for an average. In other trades similar conditions prevailed with even wider variations in the rates which might actually be earned, but he used the River Plate as an illustration, as it was the most important tramp market.

Coal cargoes, whether from this country or elsewhere, were usually fixed from one port to one port, and not often for distant loading dates, but in some trades, *e.g.* to West Italy, there was often a range of discharging ports, and sometimes charterers or owners got frightened and covered their requirements some months ahead. Even for this commodity, therefore, an average rate was not quite reliable.

Mr. Angier was sorry that his remarks should be destructive, as it was much more pleasant and profitable to be constructive, but an opinion honestly reached after—literally—generations of experience, might have some value.

Mr. Spray said he wished to support the vote of thanks which had been proposed to Dr. Isserlis for his very interesting and informative paper. As he had rightly said, papers directly bearing upon shipping read before the Society had been few and far between, and it was perhaps especially appropriate that a distinguished Honorary Secretary of the Society should have made such a valiant effort to bridge the gap since 1926 by a contribution outstanding both in quality and quantity. Most Fellows of the Society would be able to realize the amount of work entailed and the mass of detail which might be involved in presenting even the most concise statistical summary, and would therefore be well aware how much diligence must have been expended by the author and his staff in furnishing such ample fare for that evening's feast. In parentheses, he would like to say that he was interested in the reference to the notable series of papers by the late Sir John Glover, as in a humble capacity he had had a hand in compiling the last of those papers in 1902.

Mr. Spray said he had not been able to make more than a somewhat cursory examination of the paper, and he was not closely concerned with the question of freights and their fluctuations; but, as a representative of the premier society for the classification and registry of shipping (Lloyds' Register), he could not but feel that the heading of Section 2 of the paper was a little ambiguous. In view of the specialized meaning which had attached to the word "classification" in regard to ships for nearly two hundred years, perhaps the author would not mind his suggesting that some such title as "Analysis of Shipping by Trades and Voyages" or even "Classification of Tonnage" might be less open to objection. He thought the latter would be in line with the International Labour Office *Maritime Statistical Handbook*. The difficulty of distinguishing between tramp vessels and cargo liners, and between passenger liners and combined passenger and cargo vessels, was of very old standing and Dr. Isserlis was fortunate in being able to invite and obtain the co-operation of owners in making the distinction. He sympathized also with Dr. Isserlis in his remarks concerning the confusion which existed so widely—even among those who should know better—on the question of gross, net and deadweight tonnages. It would be useful to be able to refer to the concise explanation the author had given.

Mr. Spray assumed that in Table D the deadweight figures had been obtained from the owners in all cases. With regard to the item "Passenger Liners—Coasting Trade," the absence of deadweight capacity tonnages seemed to call for some explanation. Did the vessels cited include a large number of such craft as excursion steamers?

In Table F, "Invisible Exports, 1931, Contribution of Shipping Industry," there would appear to be an error. The figure of 19,600,000, given under Note F for Total Tonnage Owned in Great Britain and Ireland, as recorded in Lloyds' Register Book, was actually the figure for June 30th, 1932. The corresponding total for 1931 was 20,193,677, or, say, 20·2 m. gross tons. This would involve some slight consequential corrections in Tables F and G.

Mr. Spray wished again to express appreciation of the time and trouble the author had devoted to the subject with which he had dealt that evening.

MR. P. M. HILL, speaking on behalf of the Chamber of Shipping, expressed their indebtedness to Dr. Isserlis for his paper and for all the work he had done in the interest of statistics and the shipping industry. He had known Dr. Isserlis for fifteen years, and believed he had been somewhat of a thorn in his side, because he had not infrequently prepared statements of policy and then asked Dr. Isserlis to justify them afterwards with figures. He was bound to say that when the policy was justified, Dr. Isserlis had never failed to give them the most magnificent justification : on the other hand, when not justified, he had never failed to say so. Honest statistics of that sort were most valuable and necessary to an industry.

MR. L. C. HARRIS wished to endorse what had been said with regard to Dr. Isserlis's paper, but he did not know what he could say about the proposer of the resolution of thanks. Mr. Macrosty had let the cat out of the bag, and he now knew why he had been pushed and persuaded for years past to bring out these statistics. But statisticians must not expect to get more. The statistics were extremely important, but extremely difficult to produce, and the information could not be supplied every year or so. To his mind it was astonishing that shipowners should have been willing to reveal so much of the particulars of their business as they had done.

He was very glad to learn that he need not believe that statistics were absolutely true, but he thought they might be taken to have a general aggregate truth. After listening to the paper he had a feeling of bewilderment. Dr. Isserlis had been handling the facts of shipowning in an amazing fashion, and Mr. Harris wondered whether anything would seem to be as it was before. The marvellous skill with which these figures had been turned out was wonderful to see, but he hoped more figures would not be asked for. It might be fine sport to play with the shipowners' business, but it was very difficult to produce all the information requested.

MR. BUCKLAND said that he had been doing work in connection with tramp shipping share prices and freight rates, but had not had time to work out detailed ratios. He had noticed that during the last four years the Stock Exchange had definitely taken some cognisance of the way the freight rates had moved : also of the time charter rate, which was believed to be more sensitive.

PROFESSOR GREENWOOD said he had great pleasure in putting the vote of thanks to the Meeting. One speaker, misled by the fact that Lord Kennet was at home, unwell, had credited him with membership of the House of Lords, but no one would have the hardiness to credit him with any knowledge of shipping statistics, except that which he had gained from listening to Dr. Isserlis and the other speakers; for this reason he was afraid that he could contribute nothing to the discussion.

He would like to assure Mr. Watts, before asking him to allow himself to be proposed as a Fellow of the Society, that although there had been a good deal of discussion as to whether statistics were a science or an art, he had never heard anyone suggest that it was an exact science, and Mr. Watts need therefore have no fear of entering the Society on that ground.

Professor Greenwood now put the motion to the meeting, that the thanks of the Society be given to Dr. Isserlis for the paper he had read, and it was carried unanimously.

Dr. Snow sent the following contribution in writing:—

Had the discussion on Dr. Isserlis's paper not exhausted the time available, I should have liked to have referred to that most interesting paragraph in the paper concerning industrial cycles in general. I think that Dr. Isserlis's remarks will be found to be true of many of the single parameters which measure the state of individual industries —namely, that their periodicity and amplitude are variable, and that it is impossible to predict the position of the peak of a cycle in progress. If this is true of many of the constituents which make up the general curve of trade cycles, it seems to me that it must be true of a composite curve which claims to represent the progress of industry as a whole, and I feel considerable doubt as to whether the use of the term " cycle " is justified in describing industrial movements. The *Oxford Dictionary* defines " cycle " as " recurring period of events." It defines " recurring " as " occurring again or often, periodically," and it defines " periodically " as " at regular intervals, *e.g.* monthly." In three moves, therefore, we reach the conclusion that a cycle signifies something with regular intervals, and as these industrial movements have not regular intervals, it is unjustifiable, in my opinion, to describe them as " cycles."

The question is of more than mere academic interest. Whether or not it is proper to talk in economic circles of these movements as " cycles," the use of the term is definitely misleading in general discussions, as it gives the impression to the uninitiated that future movements can be predicted with some accuracy. When it is announced that " a study of the trade cycle leads to the conclusion that the turn will come in 1937," the man in the street is led to think that there is some real justification from the past for expecting the turn, and so far, in my opinion, this is unproven. Dr. Isserlis points out that for most of the peaks which occurred over the period about which he was speaking there was an *ad hoc* explanation. Some of them could be explained by wars, and he did not mention that the 1907 one was fully explained by the historians of it in the description " dishonest banking " in the United States. A reading of the literature of 1907 and 1908 bearing upon the American crisis makes it abundantly clear that there was an *ad hoc* reason for the peak of 1907. I think that those who sit back and allow themselves to become obsessed with the idea that the curve of trade movements over the next few years has already been roughly determined are in great danger of blinding themselves to plain facts. The falling prices of many primary products in recent months (up to November), which has been mainly responsible for what recession in trade has occurred in this country, has a clear *ad hoc* explanation, and to associate it with any rhythmical movement may be found before very long to be quite misleading.

DR. ISSERLIS, in reply, wrote :—

I feel grateful for the kind words and for the constructive criticism of those who contributed to the discussion. Mr. Macrosty suggested that the enquiries into the contribution of shipping to the balance of payments should be repeated every three years. He was sufficiently answered by Mr. Harris, who reminded the Society that the statistics were extremely difficult to produce. The burden on shipowners and on the limited staff of the Chamber had been found great even at five-year intervals.

Mr. Leak dealt mainly with weighting and missing quotations. So far as weighting is concerned, a broader basis than that given by the Subsidy data for 1935 could be found, if time permitted, by making use of the Subsidy data for the years 1936 and 1937, in addition to those of the year 1935. The new annual Board of Trade statistics, to which Mr. Leak referred, are hardly suitable for the purpose. They deal only with cargoes to and from the United Kingdom which, as Table L shows, account for little more than half of the total gross freight earned.

It is true that the proportion of outward coal from the U.K. carried by British ships rose from 38 per cent. in 1935 to 45 per cent. in 1936, but these outward coal cargoes accounted for only 16½ per cent. of the total gross freight in 1935, and, in the case of sea-going vessels of 3,000 gross tons and over, which account for 87 per cent. of the total gross freights, outward coal contributed only 11 per cent. The main object of the general tramp freight index should be to measure fluctuations in freight rates for these larger vessels. The treatment of missing quotations is, as I indicated, a matter of opinion. Tramp shipowners concur with my view that if a quotation is missing, it is best to admit it frankly, and to base the monthly index number on the material which is genuinely available.

Mr. Leak asked also why the geometric average was abandoned in the paper. The decision to use an arithmetic average is not final; it has the merit of being more easily understood by the general reader, and with the broader base provided for the new index by the greatly increased number of individual routes used, the difference between the two indices is small. The chief merits of the geometric average—that it reduces the influence of individual components liable to great fluctuations, and that it makes it easier to change the base year from time to time—have not been overlooked. But even if the geometric mean is adopted, the index will not be strictly reversible.

With Mr. Watts's remarks, to the effect that statistical indices have to be used with care and common sense, Fellows of the Society will cordially agree.

The Board of Trade statistics of the net tonnage of entrances and clearances with cargo in the foreign trade are of some use, particularly as they are the only figures available for comparisons over a series of years, or with the shipping movements in other countries. The new statistics of actual weights of cargoes now available give much-needed additional information, but are insufficient for a world picture of the movement of shipping as they are confined to the import and export trade of the U.K.

It gave me particular pleasure to hear Mr. Angier, seeing that an important section of the paper was based on the records of his family. The suggestion that copies of charter parties should be supplied to the Board of Trade is an interesting one but, as he himself pointed out later in his remarks, it is not known until the voyage materializes which of the options in the charter party has been used. I agree that the monthly index number is difficult to interpret, since the rates published during the month refer to fixtures made, and anticipate the corresponding voyages by anything from a few days to several months. The monthly index is perhaps more of a guide to the state of the market and the extent of confidence in the near future than to the freight rates at which goods were actually carried during the month. The argument applies with less force to the yearly averages. Mr. Angier will have noted that the Subsidy data of freight rates at which goods were carried during the year 1935 agreed very closely with the average of freight rates for the year, as published in the Trade Journals.

To Mr. Spray I owe thanks for a correction which has been duly noted, and an apology for my use of the phrase "Classification of Shipping." The Classification Societies, in particular Lloyd's Register, have a prior claim, and I shall try to do better in the future.

It was not possible to give a reliable deadweight figure for passenger liners' coasting trade in Table D for the earlier years. The owners omitted it quite naturally, as is shown by the small figure of 28 d.w. tons per 100 tons net in the column for June 1936. The small numbers of vessels concerned consist mostly of cross-Channel passenger vessels, including railway boats.

Dr. Snow's written contribution is a very valuable one. I agree with everything he says, and therefore do not wish to emphasize unduly the fact that quasi-periodic functions form an important subject of mathematical research at Cambridge. This has apparently escaped the notice of the compilers of the Oxford Dictionary.

As a result of the ballot taken during the meeting the candidates named below were elected Fellows of the Society :—

Archibald Gardner, M.B., Ch.B.
David Athelstane Percival.
Thomas Henry Silcock, M.A., D.Phil.Oxon.

Corporate Representative

Thomas Lachlan Drury, *representing* the General Post Office (Headquarters Library).

MISCELLANEA

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RANDOMNESS AND RANDOM SAMPLING NUMBERS

By M. G. KENDALL and B. BABINGTON SMITH

(Development of certain sections of an address on "Randomness" given by M. G. Kendall to the Study Group of the Royal Statistical Society on May 11*th*, 1937.)

Introduction

Randomness and Probability.

1. IN colloquial speech the word "random" is applied to any method of choice which lacks aim or purpose; and this usage is also found in certain sciences. In statistics, however, the word has a somewhat different and more definite significance, closely related to probability. It appears, in fact, that for statistical purposes the ideas of randomness and probability are inseparable, whether one belongs to the "intuitive" school which regards probability as an undefinable, or to the opposing "frequency" school which seeks to explain it in terms of statistical frequencies.

2. Many writers are content to define randomness in terms of probability, and this appears to be the general practice of followers of the "intuitive" school. J. M. Keynes, for example, states explicitly that randomness "must be defined with reference to probability, not to what will happen 'in the long run'; though these may be two senses of it, corresponding to subjective and objective probability respectively." * In a similar sense Jeffreys writes: "(By random) we mean that every selection of m objects

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* *A Treatise on Probability*, 1921, p. 291. Keynes' definition (taking probability as subjective) is "a is taken at random from the class S for the purposes of the propositional function $S(x) . \phi(x)$, relative to evidence h if 'x is a' is irrelevant to the probability $\phi(x)/S(x) . h$."

from the original n is equally probable."* Adherents of the "frequency" theory have an additional course open to them —namely, to define both randomness and probability in terms of frequency. Thus J. A. Venn † at the beginning of a chapter devoted to the concept of randomness says, "The scientific conception involved in the correct use of this term is, I apprehend, nothing more than that of aggregate order and individual irregularity (or apparent irregularity) which has already been described in the preceding chapters"—the chapters in question dealing with statistical series and forming the basis of Venn's theory of probability.

3. From the point of view of a formal development of the subject, the definition of randomness in terms of probability has much to recommend it, inasmuch as attention can then be centred on the latter. But the logical convenience of this course should not be allowed to lead to the neglect of a scrutiny of the concept of randomness itself, particularly in view of the practical importance of being able to judge whether any given method of sampling is random or not.

4. Whatever may be the proper relationship between the two concepts in logic, in a discussion of the technique of random sampling randomness must be considered in its own right. For the purposes of this paper the logical aspect has been relegated to the background. We take randomness and probability to be undefined ideas obeying certain intuitively formulated principles, which will be found sufficient to give results of practical application. At the same time we have every reason to suppose that the approach outlined in this paper can be formalized and put on a logical basis within the framework of existing notions on the subject and we hope to carry out this work on another occasion.

Randomness and Purpose not Antithetical.

5. It may be desirable to emphasize at the outset that statistical randomness cannot be defined in terms of absence of design. For instance, it is not legitimate to define a method of sampling as random if it follows no law of choice. So far as is known, the irrational number π gives a series of digits which are random in a certain sense. Nevertheless this series is produced by a purposive process, and is, in fact, given by a comparatively simple law of formation. The number is not random, but it *may* generate a random series of digits. The suggestion has been made that to require a series of objects to be chosen without following any law is itself to lay down a law of choice. This, we think, is a logical confusion, but the fundamental

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* *Scientific Inference*, 1931, p. 24.

† *The Logic of Chance*, 1888, p. 96.

thought behind the remark is sound—namely, that a definition of randomness must be sought elsewhere than in the negation of purpose.

Types of Universe.

6. In discussing the various problems associated with randomness and random sampling, we find it useful to distinguish between the following types of a universe of discourse.

(i) By a finite universe we mean a universe containing a finite number of members. Similarly, by an infinite universe we mean one containing an infinite number of members. In certain sampling problems it is possible to adopt modes of procedure which virtually turn a finite universe into an infinite one. If, for example, on sampling, we constantly replace the members drawn from the universe, the universe is in effect infinite, being continually replenished and never approaching exhaustion.

(ii) A continuous universe is one whose members, considered according to some variable, form a continuous set. Similarly for a discontinuous universe. Any continuous universe must be infinite, but the converse is not true. For example, the universe of positive integers is discontinuous and infinite.

It is generally assumed that continuous universes exist and, in fact, a large part of the theory of statistics depends, if not on the existence of continuous universes, at least on the supposition that many universes can, to a satisfactory degree of approximation, be represented by continuous universes.

A universe may be continuous with regard to one variate and discontinuous with regard to another. For example, the universe of rational numbers between -1 and $+1$ is continuous in regard to magnitude and discontinuous in regard to sign.

(iii) A universe is said to be existent if each member has an actual existence. For example, the universe of inhabitants of the United Kingdom is existent. We may also regard as existent a universe whose members, though not given by enumeration, are specified by a law of formation. The universe of positive integers is a case in point. But the universe of irrational numbers does not necessarily exist, and there are grounds for supposing that in fact it cannot properly be regarded as existent.

In distinction to an existent universe, a universe is said to be *hypothetical* when all its members do not exist. For example, the universe of the throws of a given die is hypothetical, and so is the universe of possible yields of wheat in a given field. We regard the distinction drawn in this paragraph as extremely important in the theory of random selection.

Random Aggregates.

7. It is in accordance with intuitive ideas on the subject that a set of entities obtained in a random way may be very unrandom in appearance. For example, a hand dealt at random from a pack of cards may consist of thirteen of a suit. It appears, therefore, that we cannot hope to define a random sample in terms of the properties of the sample itself, but only as a member of a class of samples —that is to say, by considering it as a member of a universe of higher type. What is required is a definition of a random *method* of sampling. When this is obtained a random sample can be easily defined as a sample obtained by a random method.

Random Selection from Hypothetical Universes.

8. It appears, in fact, that no aggregate of things can be said to be random unless it be considered as one of a set of such aggregates. This is one case of a general proposition which is fundamental to the frequency theory of probability. The expression " a random set of objects " may mean one of two things: either that the set was obtained by a random method, or that the objects are arranged randomly—that is to say, that their *arrangement* was chosen at random from the set of possible arrangements. In speaking of a random sample, we always mean the former.

9. At this point we rule out of the present discussion the drawing of samples from hypothetical universes. For existent universes we can clearly speak with meaning of selecting a number of members. For hypothetical universes, however, it is more doubtful whether the process of selection is really exercised at all. In sampling the throws of a die, for instance, our only method of obtaining members of the universe is actually to throw the die. To talk of the aggregate so obtained as a random selection of throws—or a selection of any kind—clearly involves certain assumptions about the nature of the event. It is a selection without a choice.

10. It appears that what actually happens in such cases is that we take the event and construct about it by a mental fiction a hypothetical universe consisting of other conceivable ways in which the event could have happened. We then assume that when the event happened it was equally possible for all the other members of the hypothetical universe to have happened too, and that for some reason or other one of these members was chosen to assume reality. This is an assumption of a different character from that met in ordinary sampling from existent universes, although the distinction has not usually been drawn. The problems which arise in this connection are, in fact, of an abstract metaphysical character

verging at times on the theological, and seem to require a good deal of further discussion. In this paper we leave these special problems on one side and confine our attention to the problems of drawing samples from existent universes only. We may, however, *utilize* material drawn from a hypothetical universe, such material forming an existent universe.

Human Bias.

11. It is becoming increasingly evident that sampling left to the discretion of a human individual is not random, although he may be completely unconscious of the existence of bias, or indeed actively endeavouring to avoid it. House-to-house sampling, the sampling of crop yields, even ticket drawing have all been found to give results widely divergent from expectation. Apart from theoretical considerations, there is thus practical evidence to show that it is insufficient to define a random method as one free from purposive selection. The criterion of randomness in selection must be of a more objective kind.

Definition of a Random Method of Selection in Terms of Independence.

12. For the purpose of the discussion we require, at this point, a notion of independence. For the present we take this concept to be undefined, merely noting that it may be expressed in terms of probability. With its aid we may define a random method of selection, applied to the characteristic C of a Universe U, as a method which is independent of C in U.

13. It is important to notice that this definition of random selection relates to a particular characteristic which is under consideration. There is no such thing as a random method of selection *per se*, considered apart from the universe whose members are being selected. A method which would be random for one universe is not necessarily random for another, and even within the same universe a method which is random in respect of one characteristic is not necessarily random in respect of another.

14. This accords with general ideas on the subject. For example, a possible method of sampling inhabitants of a street is to take, say, every tenth house. This may give a random sample, but if every tenth house is a corner house, the sample may, or may not, lose its randomness. To decide this point, we shall have to consider the properties of the universe which are under investigation. If we were inquiring into the proportion of inhabitants with blue eyes, it might be sufficient to take the corner houses, on the assumption that the colour of eyes was independent of geographical location. On the

other hand, if we were sampling for income, the method might fail, since corner houses have, in general, higher rents and rates than others, and we should therefore expect to find them inhabited by people with larger incomes.

15. A practical question of great importance which arises in this connection is: How are we to determine whether a given method is independent of a given characteristic? The answer is that we cannot determine it without doubt, for to do so would require a full knowledge of the universe; and this is almost always in practice denied us, for otherwise there would be no point in a sampling inquiry. The assumption of independence must therefore be made with more or less confidence on *a priori* grounds. It is part of the hypothesis on which our ultimate expression of opinion is based.

The Use of Digits in Random Sampling.

16. Although a random method is necessarily related to a characteristic of the universe, one frequently requires a sample which may be regarded as random in respect of all the characteristics of the universe. It might be thought, at first sight, that it would be impossible to draw a random sample for this purpose, because, in the very nature of selection, it is necessary to sample according to at least one characteristic of the universe; and this particular characteristic can hardly be independent of the method of selection when, in fact, that method is based upon it.

17. In practice this difficulty can most conveniently be overcome by superposing on the universe a new characteristic and sampling according to that characteristic. By far the most serviceable characteristic which can be superposed on an enumerable universe is that of ordinal number. If we can number our universe, the problem of drawing a random sample reduces to that of finding a series of random numbers.

18. One point should be made clear here. If the numbering of the universe is carried out in such a way as to be independent of the other characteristics of the universe, any set of numbers will serve to draw a random sample. The randomness in such a case lies, so to speak, in the allocation of ordinals to the universe, not in deciding which ordinals to select for the sample. But in practice a procedure of this kind is of no value, since it only throws back to the difficulty of numbering the universe "at random." The usual course is to number the universe in any convenient way, related to the characteristics or not, and then seek for a set of numbers which are a random set from the possible ordinals of the universe.

19. This procedure has the additional advantage that it saves a great deal of labour and narrows the field of inquiry enormously.

Instead of having to examine on every occasion whether our sampling method is really independent of the properties of the universe, we can confine ourselves to the single question whether we can construct a set of digits which will provide a random sample of any desired size from any finite set of integers, it being almost certain that the arrangement of digits in the sampling numbers will be independent of the characteristics of the universe. This is the fundamental problem in the construction of sets of " random sampling numbers." As is shown below, it does not admit of a complete solution.

Random Sampling Numbers

20. Any set of digits whatsoever is random in the sense that it might arise in random sampling from a infinite universe of digits; but such a set is not necessarily one which can be used for random sampling, as, for instance, if it consists of a block of zeros. A set of Random Sampling Numbers (by which is meant a set of numbers which can be used for random sampling, not necessarily a set obtained by random methods) must therefore conform to certain requirements other than that of having been chosen at random.

21. If a random method is repeatedly applied to a universe consisting of a finite number of distinct species of object, each species being present in equal and infinite amount, we expect that in a large number of trials each type of object will appear an approximately equal number of times. It follows that in a set of N Random Sampling Numbers we should expect each digit to occur in approximately $N/10$ cases, for the set may be used to draw the ten digits, 0 to 9, of which it is composed. By an extension of this result we should also expect each *pair* of digits to occur an approximately equal number of times, or, put another way, we should expect that no digit would tend to be followed by any other; and so on.

22. As has been stated, any given set of N need not conform to such expectations; but a Random Sampling set should do so. We accordingly call such a set *locally random*, and define it as a set which conforms approximately to expectation among all possible sets of N.

23. To complete the definition it is necessary to make precise the meaning of " approximately " in the statement that certain frequencies are approximately 10 per cent. of the total, etc., in a locally random set. To decide this point we have to consider a given set of N as a member of a universe of sets of N. The proportions in such a universe will give a frequency distribution, and in particular the divergences of expectation from actuality can be combined into a χ^2 distribution. On purely arbitrary grounds we take the χ^2 test to give a measure of permissible divergence from

expectation. That is to say, if we have expectations $\tilde{m}$ and actual frequencies m

$$\chi^2 = S\left\{\frac{(\tilde{m} - m)^2}{m}\right\}$$

$$P = \frac{\int_{\chi}^{\infty} e^{-\frac{\chi^2}{2}} \chi^{\nu-1} d\chi}{\int_{0}^{\infty} e^{-\frac{\chi^2}{2}} \chi^{\nu-1} d\chi}$$

where ν is the number of degrees of freedom and the m's will be permissible if, say, $0{\cdot}01 < P < 0{\cdot}99$. In such circumstances the frequencies are " approximately " in accordance with expectation.

Four Tests for Local Randomness.

24. For practical purposes in deciding whether a given set is locally random, we have found that the following four tests are useful and searching. They are, however, not sufficient to establish the existence of local randomness, although they are necessary.

(*a*) The first and most obvious test to be applied is that all the digits shall occur an approximately equal number of times. This test we call the *frequency test*;

(*b*) Secondly, if the series is locally random, no digit shall tend to be followed by any other digit. If therefore we form a bivariate table showing the distribution of pairs of digits in the series, arranged in the rows according to the first digit, and in the columns according to the second digit, we should get frequencies which are approximately equal in all the cells. This test we refer to as the *serial test*;

(*c*) Thirdly, if the digits are arranged in blocks of, say, five, there will be certain expectation of the numbers in which the five digits are all the same, the numbers in which there are four of one kind, and so on. This test we refer to as the *poker test*, from an analogy with the card game;

(*d*) Finally, there are certain expectations in regard to the gaps occuring between the same digits in the series. For instance, if we take one digit, say, zero, in about one-tenth of the cases the first zero will be followed immediately by a second zero, and there will be no gap. In about nine-hundredths of the cases there will be one digit between two zeros. In about eighty-one-thousandths of the cases there will be a gap of two digits between successive zeros, and so on. This we call the *gap test*.

25. These four tests taken together are very powerful. It is comparatively easy to form series that evade the first three. For example, the recurring series, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, evades the frequency test, the series 1–2–3–4–, etc., evades the frequency test, and the serial test if the dashes are filled with random digits. We have, however, not succeeded in constructing a series which would certainly evade the gap test. Such a series would, it appears, have to have a very peculiar bias indeed, such as would hardly ever rise in practice.

26. The gap test may be extended. Not only will there be an expectation of the frequency of the gaps, but there will also be an expectation of the gaps between gaps of the same kind; these in turn will have expected gaps between them, and so on. There is thus an infinite sequence of the gap tests no one of which includes the others. All these tests are necessary for local randomness, though we have not established their sufficiency. It appears, therefore, that there is no finite set of tests of this character which is sufficient to demonstrate the local randomness of all finite sets of numbers.

27. There is clearly something conventional about the permissible limits of local randomness. To make the concept more precise, we should perhaps speak of a series as being locally random in a certain test Domain. In this connection it should be noticed that if two series S and T are each locally random in a test Domain, it does not follow that the sum of the series $S + T$ is also locally random in that Domain. Further, if a series S is locally random in a Domain, it does not follow that any part of S is locally random in that Domain.

28. This last result is very important. A Random Sampling set may be locally random, and therefore satisfactory, when taken as a whole; but a section of it may not. The familiar process of "taking a page" from a book of random numbers therefore requires some further examination.

Consider an extreme case. Suppose we construct a Random Sampling set consisting of $10^{10^{10}}$ digits. The chance that any given block of a million consists of zeros is 10^{-10^6}. Such a set should therefore occur at least $10^{(10^{10}-10^6-6)}$ times, *i.e.*, is practically certain. If it did not occur, we should probably reject the whole set as not being locally random. Clearly, however, this block of a million zeros is not locally random, and if we turned to the pages in the table at which it occurred, we should not be able to use it to draw random samples which only required that block.

29. It follows that a Random Sampling set cannot be used indiscriminately to draw any given number of samples of any given size

from any given universe until it has been tested for local randomness not only as a whole, but in the parts which it is proposed to use separately. It follows further from the previous paragraph that a perfect Random Sampling set is impossible—there can never be compiled a set of Random Sampling Numbers which are adequate for all requirements. A set may be useful over a certain range—for instance, a set of a million might be locally random for sampling which required a batch of ten digits or more; but as the size of the set increases, there are bound to appear bad patches which are, in themselves, not locally random.

Production of Locally Random Series.

30. It has long been held that mechanical methods of producing random series of integers do not give satisfactory results. Dice-throwing, for example, to give a random series of the integers 1 to 6, notoriously results in bias. Nor are roulette tables much better. Karl Pearson has shown [*] by analysis of the gaming results at Monte Carlo that the odds against the absence of bias are exceedingly large. The source of this bias is not altogether clear, but if we exclude the possibilities of deliberate falsification, it would appear to arise from small imperfections in the roulette wheel which direct the ball into some compartments in preference to others.

31. So far as we are aware, the only tables of random numbers at present in existence are those due to L. H. C. Tippett, who compiled them by taking digits "at random" from census reports. This amounts to an abandonment of the mechanical method in favour of one which may reasonably be supposed to be free from bias. The reliability of such numbers must, however, depend on the results which they give, and it is stated (in the introduction to these tables) that Tippett's numbers have been found by experiment to give results in accordance with expectation. In view of the position in regard to local randomness revealed by the foregoing analysis, it would appear desirable to examine these tables again to determine the ranges within which they are locally random. We refer below to some tests we have ourselves carried out on those numbers.[†]

32. The selection of digits from apparently random distributions must be made with some caution. We have attempted to construct a random series by selecting digits from the London Telephone Directory. In order to exclude bias as far as possible, pages were taken by opening the book haphazardly; numbers of less than four digits were ignored; numbers associated with names printed in heavy type were also ignored; and only the two right-hand digits were taken.

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[*] *Chances of Death*, Vol. I. See also *Phil. Mag.*, 5th Series, Vol. I, 1900, p. 157.

[†] See also the note by Mr. Udny Yule following this paper.

It was found that a series of this kind was significantly biased. There appeared a deficiency of fives and nines, as the following table shows :

TABLE I

Distribution of 10,000 *Digits taken Haphazard from the London Telephone Directory*

Digit	0	1	2	3	4	5	6	7	8	9	Total
Frequency	1026	1107	997	966	1075	933	1107	972	964	853	10,000

$\chi^2 = 58{\cdot}582.$ $P =$ less than 0·000,000,1.

The reasons for this effect are complicated, and are not confined to the obvious one that Telephone Engineers would avoid fives and nines because of their assonance. It thus appears that the London Directory is useless as a source of random digits.

The Randomising Machine.

33. We have designed an apparatus which, so far as we have been able to test, appears to give locally random sequences of random digits. Essentially the machine consists of a disc divided into ten equal sections, on which the digits 0 to 9 are inscribed. The disc rotates rapidly at a speed which can, if necessary, be made constant to a high degree of approximation by means of a tuning-fork. The experiment is conducted in a dark room, and the disc is illuminated from time to time by an electric spark or by a flash of a neon lamp, which is of such short duration that the disc appears to be at rest. At each flash a number is chosen from the apparently stationary disc by means of a pointer fixed in space.

In the actual experiment, the disc was rotated by an electric motor at about 250 revolutions per minute. It was illuminated by a neon lamp in parallel with a condenser in an independent electric circuit which was broken by means of a key. Owing to experimental conditions, the time between the making of the circuit and the passing of the flash varied, but to add an extra element of randomness the key was tapped irregularly by the experimenter. Flashes occurred, on the average, about once in three or four seconds.

Test of Results.

34. The first five thousand digits obtained in this way are given in the Appendix.* We have applied to them the four tests previously mentioned with the following results :—

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* It should perhaps be pointed out that all these numbers were taken from the machine by the same experimenter. As opportunity permits, we propose to examine the unlikely possibility that other observers would produce non-locally random sets.

TABLE II

Serial Test of the 5,000 *Digits of the Appendix*

First Digit

Second Digit	0	1	2	3	4	5	6	7	8	9	Total
0	47	61	44	52	44	56	39	39	50	52	484
1	51	34	33	62	45	44	49	49	46	53	466
2	43	56	64	50	45	43	54	42	51	55	503
3	47	46	63	50	68	41	55	50	47	47	514
4	45	49	54	40	46	59	56	51	51	48	499
5	47	41	59	44	44	54	67	58	42	55	511
6	58	43	56	58	58	52	57	44	51	45	522
7	50	48	35	56	41	48	46	42	65	56	487
8	52	49	45	53	58	44	43	49	48	52	493
9	44	39	50	49	50	70	56	63	42	58	521
Total	484	466	503	514	499	511	522	487	493	521	5000

The above table was formed by entering a pair XY in the Xth column and the Yth row; *e.g.*, the first three numbers 231 give rise to a unit in the second column and the third row, and one in the third column and first row. To make the 5,000 digits yield exactly 5,000 pairs, the last digit was taken with the first to form the pair 02.

It will be seen that the total of the Xth row is the same as the total for the Xth column.

Frequency Test.

The frequencies of digits are those given in the marginal row or column. The expectation is 500 in each cell, and the number of degrees of freedom is 9.

We find $\chi^2 = 5{\cdot}76$. $P = 0{\cdot}76$ approx.
and the test is favourable.

Serial Test.

For this test we compare the frequency in each cell of the body of the table with the theoretical frequency 50. It should be noted that the table is different from an ordinary contingency table, although resembling it in form, for the theoretical frequencies are not calculated from the marginal frequencies. The number of degrees of freedom, ν, is 90. There are 10 linear constraints imposed by the condition that totals of corresponding rows and columns are the same, but only 9 of these are independent; and there is one constraint imposed by the total frequency.

We find

$$\chi^2 = 110{\cdot}44, \ \sqrt{2\chi^2} = 14{\cdot}86$$
$$\sqrt{2\nu - 1} = \sqrt{179} = 13{\cdot}38.$$

The deviation of $\sqrt{2\chi^2}$ is 1·48, giving a probability P of 0·07—within permissible limits.

Poker Test.

The expected and observed frequencies in the 1,000 groups of fives are as follows:

Type	Observed Frequency	Expected Frequency
aaaaa	1	0·1
aaaab	6	4·5
aaabb	9	9
aaabc	75	72
aabbc	101	108
aabcd	501	504
abcde	307	302·4
	1,000	1,000·0

Running together the first three frequencies, we find $\chi^2 = 1{\cdot}09$, $\nu = 4$, $P = 0{\cdot}9$ approx., a favourable result.

Gap Test.

The gap test carried out on the zeros of the table gives the following :—

Size of Gap	Observed Frequency	Expected Frequency
0	48	48·3
1	43	43·5
2	38	39·1
3	39	35·2
4	25	31·7
5	28	28·5
6	23	25·7
7	31	23·1
8	22	20·8
9	17	18·7
10	15	16·8
11	17	15·2
12	12	13·6
13	10	12·3
14	10	11·0
15	13	9·9
16–20 inclusive	33	36·7
21–25 ,, ...	18	21·6
26 and over	41	31·2
	483	482·9

$\chi^2 = 11{\cdot}22$, $\nu = 18$, $P = 0{\cdot}88$, again favourable

The set of 5,000 is thus locally random in the fourfold test domain. We may add that the individual sets of 1,000 are also locally random.

35. It might be thought that the pursuit of a mechanical method for giving random series is akin to that of a machine for achieving perpetual motion. No matter how good the machine is and how efficient the technique under which the experiment is conducted, there are always conceivable sources of bias which may deprive the results of randomness. This objection, however, could be lodged against any method of constructing Random Sampling Numbers, and does not in our opinion affect the value of a series obtained mechanically, since we are not looking for a machine to construct a perfectly random series, whatever that may mean, but only one in which the bias, if any, should fall below the threshold of permissible limits imposed by the nature of the tests which we apply—in short, that it should be *locally* random. The series we have obtained appears to conform to these requirements at least for sets of 5,000. Further experiments would be desirable before it can be regarded as established that the machine will give locally random sets of greater number; but the above results are encouraging and provide at least a *prima facie* case.

Test of Tippett's Numbers.

36. We may compare the analysis of the five thousand digits of Appendix I with that of the first thousand and the last thousand of Tippett's numbers, which are as follows :—

TABLE III

Serial Test on Tippett's First Thousand

First Digit

Second Digi	0	1	2	3	4	5	6	7	8	9	Total
0	11	9	8	14	12	13	10	13	2	4	96
1	14	17	9	10	13	8	8	9	10	12	110
2	11	10	5	8	15	10	9	7	10	11	96
3	4	13	8	7	12	4	16	13	10	12	99
4	4	11	12	16	12	10	9	8	8	12	102
5	13	14	6	10	4	8	13	8	10	16	102
6	7	10	14	8	11	15	14	15	7	10	111
7	10	12	13	9	6	13	10	7	9	10	99
8	15	9	8	6	8	8	11	5	8	5	83
9	7	5	13	11	9	13	11	14	9	10	102
Total	96	110	96	99	102	102	111	99	83	102	1000

For the *frequency test*, $\chi^2 = 5{\cdot}56$, $P =$ about 0·78.
For the *serial test*, $\chi^2 = 100{\cdot}4$, $P =$ about 0·21.
The *poker test* for groups of four gives—

Type	Observed Frequency	Theoretical Frequency
aaaa	0	0·25
aaab	10	9
aabb	9	6·75
aabc	103	108
abcd	128	126
	250	250·00

Running together the first two frequencies, $\chi^2 = 1{\cdot}07$, $\nu = 3$, $P =$ about 0·79.

The *gap test* for the 96 zeros gives—

Size of Gap	Observed Frequency	Theoretical Frequency
0 to 2 (inclusive)	25	26·0
3 ,, 5 ,, ...	19	19·0
6 ,, 8 ,, ...	13	13·8
9 ,, 11 ,, ...	10	10·1
18 and over	28	26·1
	95	95·0

TABLE IV

Serial Test for the Last 1,000 *of Tippett's Numbers*

First Digit

Second Digit	0	1	2	3	4	5	6	7	8	9	Total
0	10	9	12	17	9	9	10	8	10	13	107
1	13	7	11	6	10	5	7	5	12	13	89
2	6	10	16	9	8	15	14	9	8	7	102
3	15	10	10	9	8	15	8	13	9	10	107
4	12	8	10	8	7	8	14	5	14	8	94
5	10	8	9	17	14	9	5	12	10	11	105
6	7	9	8	14	10	10	9	10	16	10	103
7	11	8	7	4	11	8	12	6	9	10	86
8	12	9	11	15	7	15	8	7	7	11	102
9	11	11	8	8	10	11	16	11	7	12	105
Total	107	89	102	107	94	105	103	86	102	105	1000

$\chi^2 = 0{\cdot}2242$, $P = 0{\cdot}994$. This is probably admissible, in view of the small frequency and the approximate nature of the theoretical frequencies.

We conclude that the set of 1,000 is locally random so far as these tests are concerned.

For the frequency test $\chi^2 = 5{\cdot}18$, $P =$ about 0·82.

For the serial text $\chi^2 = 83{\cdot}6$, $P =$ about 0·67.

For the poker test we find, with a similar grouping to that employed for the first thousand, $\chi^2 = 0{\cdot}634$, $P =$ about 0·89.

For the gap test applied to zeros, we find $\chi^2 = 1{\cdot}16$, $P =$ about 0·88.

37. These results indicate that the first and last thousand of Tippett's tables are locally random sets. But the fact that two chosen at random have been found to be locally random affords little evidence that each of the other 39 thousands is locally random; nor does it follow that the whole 41,600 form a locally random set. To apply the serial test to the whole table would require an amount of labour for which we have not the time. In connection with some other experiments we have, however, obtained certain results which have a bearing on the question.

38. In these experiments 2,000 random permutations of the digits 0 to 9 were obtained from Tippett's tables in the following way: the observer went through the tables from the beginning, writing down the digits as they occurred, but omitting those which had occurred already. When nine out of the ten possible digits had been obtained, the last was filled in without reference to the tables, and the observer began again on a new permutation. The whole 2,000 permutations used about 39,000 Tippett digits, *i.e.*, practically the whole table.

In the permutations so obtained the occurrences of the six possible arrangements of certain triads were counted. The results for the first 1,920 permutations with the digits 1, 2, 3 are as follows:—

Permutation	Observed Frequency
1 2 3	302
1 3 2	296
2 1 3	339
2 3 1	327
3 1 2	323
3 2 1	333

The expected frequency in each class is 320, and $\chi^2 = 4{\cdot}65$, $P =$ about 0·46.

So far as this limited test is concerned, the table appears to be locally random.

Necessity for More Extended Tables of Random Numbers.

39. Whether Tippett's tables are locally random or not, there is some need for a more extended locally random set. Tippett's numbers are very limited in size, there being only about forty thousand of them. For many sampling purposes this is sufficient, but if we wish to draw a large number of samples from a large universe Tippett's numbers would, we think, be unsatisfactory.

Suppose, for example, we wished to apply a random series of numbers to draw a thousand random samples of 100 from a universe of one million individuals.* In order to specify the individuals, it is necessary to use six digits. The thousand samples of 100, therefore, require six hundred thousand digits, or a table about fifteen times as large as Tippett's.

40. In practice, a situation of this kind has sometimes been met by using Tippett's tables over and over again with variations, *e.g.*, by going through the tables once taking digits horizontally, then taking digits vertically, or taking every other digit, and so on. Although this procedure might give satisfactory results in some cases, the total set of digits so obtained may very well not be locally random. In fact, any test which uses the same set of digits over and over again must be invalid if the set is used sufficient times.

To prove this result, consider a set N used m times, and consider the gap test applied to the zeros of the table. A gap greater than $2N$ is impossible, and hence the observed frequencies of gaps of $2N$ or over must be zero. But as m increases, the theoretical frequency of these gaps increases, and hence the contribution to χ^2 increases without limit; and as the number of degrees of freedom remains constant, there must come a time when the set mN falls outside the test-domain, however generously the latter is determined.

41. It appears, therefore, that the practice of using a Random Sampling set more than once must be regarded with distrust until it has been shown that the multiple of the set is locally random. This is true whether the set is taken in a different order or not. The labour of demonstration in such a case would be enormous; but until it is carried out the practice will be surrounded by doubt.

Note.—Since the above paper was written we have seen a paper by W. O. Kermack and A. G. McKendrick on " Tests for Randomness in a Series of Numerical Observations " (*Proc. Roy. Soc., Ed.*, vol. 57, 1936–7, Part 3, pp. 228–40). Kermack and McKendrick give a test for periodicities in series of numbers which is distinct in type from those proposed in the foregoing. They apply this test to

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* This is not in the least a fantastic case. A problem of the same magnitude would arise if one wished to take a sample of 100,000 from the agricultural holdings over one acre in England and Wales, which number about 400,000.

Tippett's numbers (though apparently only to about 1,500 of them) and to certain telephone numbers, finding it favourable to randomness in both cases. The latter result stands in contrast to our results with London telephone numbers, but Kermack and McKendrick are apparently dealing with a five-figure Scottish exchange.

Appendix

Random Sampling Numbers Produced by the Machine

1st *Thousand*

23157	54859	01837	25993	76249	70886	95230	36744
05545	55043	10537	43508	90611	83744	10962	21343
14871	60350	32404	36223	50051	00322	11543	80834
38976	74951	94051	75853	78805	90194	32428	71695
97312	61718	99755	30870	94251	25841	54882	10513
11742	69381	44339	30872	32797	33118	22647	06850
43361	28859	11016	45623	93009	00499	43640	74036
93806	20478	38268	04491	55751	18932	58475	52571
49540	13181	08429	84187	69538	29661	77738	09527
36768	72633	37948	21569	41959	68670	45274	83880
07092	52392	24627	12067	06558	45344	67338	45320
43310	01081	44863	80307	52555	16148	89742	94647
61570	06360	06173	63775	63148	95123	35017	46993
31352	83799	10779	18941	31579	76448	62584	86919
57048	86526	27795	93692	90529	56546	35065	32254
09243	44200	68721	07137	30729	75756	09298	27650
97957	35018	40894	88329	52230	82521	22532	61587
93732	59570	43781	98885	56671	66826	95996	44569
72621	11225	00922	68264	35666	59434	71687	58167
61020	74418	45371	20794	95917	37866	99536	19378
97839	85474	33055	91718	45473	54144	22034	23000
89160	97192	22232	90637	35055	45489	88438	16361
25966	88220	62871	79265	02823	52862	84919	54883
81443	31719	05049	54806	74690	07567	65017	16543
11322	54931	42362	34386	08624	97687	46245	23245

2nd *Thousand*

64755	83885	84122	25920	17696	15655	95045	95947
10302	52289	77436	34430	38112	49067	07348	23328
71017	98495	51308	50374	66591	02887	53765	69149
60012	55605	88410	34879	79655	90169	78800	03666
37330	94656	49161	42802	48274	54755	44553	65090
47869	87001	31591	12273	60626	12822	34691	61212
38040	42737	64167	89578	39323	49324	88434	38706
73508	30908	83054	80078	86669	30295	56460	45336
32623	46474	84061	04324	20628	37319	32356	43969
97591	99549	36630	35106	62069	92975	95320	57734
74012	31955	59790	96982	66224	24015	96749	07589
56754	26457	13351	05014	90966	33674	69096	33488
49800	49908	54831	21998	08528	26372	92923	65026
43584	89647	24878	56670	00221	50193	99591	62377
16653	79664	60325	71301	35742	83636	73058	87229
48502	69055	65322	58748	31446	80237	31252	96367
96765	54692	36316	86230	48296	38352	23816	64094
38923	61550	80357	81784	23444	12463	33992	28128
77958	81694	25225	05587	51073	01070	60218	61961
17928	28065	25586	08771	02641	85064	65796	48170
94036	85978	02318	04499	41054	10531	87431	21596
47460	60479	56230	48417	14372	85167	27558	00368
47856	56088	51992	82439	40644	17170	13463	18288
57616	34653	92298	62018	10375	76515	62986	90756
08300	92704	66752	66610	57188	79107	54222	22013

3rd Thousand

89221	02362	65787	74733	51272	30213	92441	39651
04005	99818	63918	29032	94012	42363	01261	10650
98546	38066	50856	75045	40645	22841	53254	44125
41719	84401	59226	01314	54581	40398	49988	65579
28733	72489	00785	25843	24613	49797	85567	84471
65213	83927	77762	03086	80742	24395	68476	83792
65553	12678	90906	90466	43670	26217	69900	31205
05668	69080	73029	85746	58332	78231	45986	92998
39302	99718	49757	79519	27387	76373	47262	91612
64592	32254	45879	29431	38320	05981	18067	87137
07513	48792	47314	83660	68907	05336	82579	91582
86593	68501	56638	99800	82839	35148	56541	07232
83735	22599	97977	81248	36838	99560	32410	67614
08595	21826	54655	08204	87990	17033	56258	05384
41273	27149	44293	69458	16828	63962	15864	35431
00473	75908	56238	12242	72631	76314	47252	06347
86131	53789	81383	07868	89132	96182	07009	86432
33849	78359	08402	03586	03176	88663	08018	22546
61870	41657	07468	08612	98083	97349	20775	45091
43898	65923	25078	86129	78491	97653	91500	80786
29939	39123	04548	45985	60952	06641	28726	46473
38505	85555	14388	55077	18657	94887	67831	70819
31824	38431	67125	25511	72044	11562	53279	82268
91430	03767	13561	15597	06750	92552	02391	38753
38635	68976	25498	97526	96458	03805	04116	63514

4th Thousand

02490	54122	27944	39364	94239	72074	11679	54082
11967	36469	60627	83701	09253	30208	01385	37482
48256	83465	49699	24079	05403	35154	39613	03136
27246	73080	21481	23536	04881	89977	49484	93071
32532	77265	72430	70722	86529	18457	92657	10011
66757	98955	92375	93431	43204	55825	45443	69265
11266	34545	76505	97746	34668	26999	26742	97516
17872	39142	45561	80146	93137	48924	64257	59284
62561	30365	03408	14754	51798	08133	61010	97730
62796	30779	35497	70501	30105	08133	00997	91970
75510	21771	04339	33660	42757	62223	87565	48468
87439	01691	63517	26590	44437	07217	98706	39032
97742	02621	10748	78803	38337	65226	92149	59051
98811	06001	21571	02875	21828	83912	85188	61624
51264	01852	64607	92553	29004	26695	78583	62998
40239	93376	10419	68610	49120	02941	80035	99317
26936	59186	51667	27645	46329	44681	94190	66647
88502	11716	98299	40974	42394	62200	69094	81646
63499	38093	25593	61995	79867	80569	01023	38374
36379	81206	03317	78710	73828	31083	60509	44091
93801	22322	47479	57017	59334	30647	43061	26660
29856	87120	56311	50053	25365	81265	22414	02431
97720	87931	88265	13050	71017	15177	06957	92919
85237	09105	74601	46377	59938	15647	34177	92753
75746	75268	31727	95773	72364	87324	36879	06802

5th Thousand

29935	06971	63175	52579	10478	89379	61428	21363
15114	07126	51890	77787	75510	13103	42942	48111
03870	43225	10589	87629	22039	94124	38127	65022
79390	39188	40756	45269	65959	20640	14284	22960
30035	06915	79196	54428	64819	52314	48721	81594
29039	99861	28759	79802	68531	39198	38137	24373
78196	08108	24107	49777	09599	43569	84820	94956
15847	85493	91442	91351	80130	73752	21539	10986
36614	62248	49194	97209	92587	92053	41021	80064
40549	54884	91465	43862	35541	44466	88894	74180
40878	08997	14286	09982	90308	78007	51587	16658
10229	49282	41173	31468	59455	18756	08908	06660
15918	76787	30624	25928	44124	25088	31137	71614
13403	18796	49909	94404	64979	41462	18155	98335
66523	94596	74908	90271	10009	98648	17640	68909
91665	36469	68343	17870	25975	04662	21272	50620
67415	87515	08207	73729	73201	57593	96917	69699
76527	96996	23724	33448	63392	32394	60887	90617
19815	47789	74348	17147	10954	34355	81194	54407
25592	53587	76384	72575	84347	68918	05739	57222
55902	45539	63646	31609	95999	82887	40666	66692
02470	58376	79794	22482	42423	96162	47491	17264
18630	53263	13319	97619	35859	12350	14632	87659
89673	38230	16063	92007	59503	38402	76450	33333
62986	67364	06595	17427	84623	14565	82860	57300

A TEST OF TIPPETT'S RANDOM SAMPLING NUMBERS

By G. UDNY YULE, F.R.S.

WHILE carrying out some sampling experiments last year on the basis of Tippett's "Random Sampling Numbers," I got an impression that the series was rather "patchy." It is obvious that any such impression is quite valueless, but, in spite of the favourable results given by the tests used by Mr. Kendall,* with whom I was in correspondence, it left such a sense of discomfort that it finally drove me to make the test now described.

If our problem is concerned with sampling from a normal universe, using Tippett's numbers in the way described in Illustration I of the "Foreword," the leading digits of the four-figure numbers are of principal importance. I decided therefore to carry out the test on these, adding them in sequences of five and comparing the distribution of the sums with expectation. The digits were added in sequences of five down the *columns* as tabulated, so that *e.g.* the first three sums on p. I are

$$\begin{aligned} 2+4+2+0+2 &= 10, \\ 5+9+2+9+8 &= 33, \\ 5+1+6+2+5 &= 19. \end{aligned}$$

A distribution was then compiled for seven sets of such sums covering the whole book : viz. six sets of 300 observations and one for the remainder of 280. The respective distributions are thus based on the following pages (roman) and columns (arabic) of the book :—

1.	300	observations.	I to IV. 6
2.	„	„	IV. 7 to VIII. 4
3.	„	„	VIII. 5 to XII. 2
4.	„	„	XII. 3 to XV. 8
5.	„	„	XVI. 1 to XIX. 6
6.	„	„	XIX. 7 to XXIII. 4
7.	280	„	XXIII. 5 to XXVI. 8.

The expected distribution for the sum of five digits taken at random from 0 to 9 is shown in Table I. This was obtained by a simple step-by-step process. For samples of a single digit only the distribution is evidently uniform over the range 0 to 9, say $1+1+\ .\ \ .\ \ .+1+1=10$. Call this distribution D_1. For samples of two digits, since they are independent, the distribution will be given by drawing up a correlation table, entering the dis-

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* See preceding paper, p. 147.

TABLE I

Expected Distribution for the Sum of 5 *Digits taken at Random from* 0 *to* 9

x	Frequency	x	Frequency
0, 45	1	13, 32	2,205
1, 44	5	14, 31	2,710
2, 43	15	15, 30	3,246
3, 42	35	16, 29	3,795
4, 41	70	17, 28	4,335
5, 40	126	18, 27	4,840
6, 39	210	19, 26	5,280
7, 38	330	20, 25	5,631
8, 37	495	21, 24	5,875
9, 36	715	22, 23	6,000
10, 35	996		
11, 34	1,340	Grand total	100,000
12, 33	1,745		

tribution D_1 along the top and side, placing the products of these total frequencies (units in this case) in the cells, and adding the diagonals running up from left to right. This case is so simple that it is hardly necessary actually to carry out the process: it will evidently give the distribution $1 + 2 + 3 + \ldots + 9 + 10 + 9 + \ldots + 3 + 2 + 1 = 100$, covering the range 0 to 18. Call this distribution D_2. Next draw up a correlation table with, say, D_1 along the top, D_2 along the side, enter products in the cells, sum diagonals as before, and we have the distribution for the sums of three digits D_3. Finally drawing up a correlation table with D_2 along the top, D_3 along the side, entering products in the cells, and summing diagonals as before, we have the required distribution for the sums of five digits D_5, the distribution of Table I. The process is simpler and shorter than it sounds, and checks at each stage, as the total for D_r must be 10^r.

The distribution of Table I is evidently symmetrical: the moment coefficients are

$$\mu_2 = 41{\cdot}25$$
$$\mu_4 = 4688{\cdot}0625$$
$$\beta_2 = 2{\cdot}75515.$$

The standard deviation is 6·422616, and this gives for the standard errors of the means of the aggregate of observations and of the respective sets,

2080 observations : $\epsilon_m = 0{\cdot}140825$
300 ,, : $\epsilon_m = 0{\cdot}370810$
280 ,, : $\epsilon_m = 0{\cdot}383825.$

TABLE II

Distributions of Totals of Sequences of 5 *Leading Digits in Tippett's Tables*

Total of 5 Digits	Distribution in Set of Observations—							Summary	Expectation
	1	2	3	4	5	6	7		
0	—	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	0·1
2	—	—	—	—	—	—	—	—	0·3
3	—	—	—	—	—	1	—	1	0·7
4	1	—	—	—	—	—	—	1	1·5
5	—	—	—	2	—	1	1	4	2·6
6	3	1	1	1	2	2	—	10	4·4
7	2	1	—	1	3	—	2	9	6·9
8	2	—	1	2	1	2	1	9	10·3
9	2	—	2	6	5	—	3	18	14·9
10	4	5	3	4	3	2	3	24	20·7
11	6	1	7	3	4	2	2	25	27·9
12	9	4	3	8	4	6	5	39	36·3
13	1	3	5	6	8	8	8	39	45·9
14	10	9	12	9	9	9	10	68	56·4
15	14	10	4	7	15	6	9	65	67·5
16	10	13	6	10	9	15	10	73	78·9
17	12	14	9	19	11	13	14	92	90·2
18	18	19	17	11	14	24	16	119	100·7
19	15	10	12	20	19	20	12	108	109·8
20	19	16	20	15	17	8	22	117	117·1
21	10	25	24	17	19	19	8	122	122·2
22	20	19	14	14	15	19	15	116	124·8
23	11	20	18	14	20	24	23	130	124·8
24	19	19	19	32	13	10	9	121	122·2
25	18	13	16	14	11	16	16	104	117·1
26	17	14	18	9	18	10	20	106	109·8
27	19	18	22	8	8	15	19	109	100·7
28	11	17	16	11	20	11	10	96	90·2
29	12	17	15	8	12	8	7	79	78·9
30	4	4	10	13	9	10	12	62	67·5
31	9	7	11	11	7	14	7	66	56·4
32	6	6	4	8	8	8	3	43	45·9
33	3	2	3	3	4	6	1	22	36·3
34	4	3	4	6	2	5	4	28	27·9
35	3	6	1	4	2	1	4	21	20·7
36	3	—	1	1	3	2	1	11	14·9
37	1	2	1	2	3	1	1	11	10·3
38	1	—	—	—	1	1	1	4	6·9
39	1	1	1	—	—	1	—	4	4·4
40	—	1	—	—	—	—	—	1	2·6
41	—	—	—	1	—	—	—	1	1·5
42	—	—	—	—	1	—	1	2	0·7
43	—	—	—	—	—	—	—	—	0·3
44	—	—	—	—	—	—	—	—	0·1
45	—	—	—	—	—	—	—	—	—
Total	300	300	300	300	300	300	280	2,080	2,080·2

For the standard error of the standard deviation we have

$$\varepsilon^2_\sigma = \frac{1}{n}\frac{\mu_4 - \mu^2_2}{4\mu_2}$$
$$= \frac{1}{n}\frac{2986{\cdot}5}{165}$$
$$= \frac{1}{n}18{\cdot}1,$$

which gives

2080 observations : $\varepsilon_\sigma = 0{\cdot}093284$
300 ,, $\varepsilon_\sigma = 0{\cdot}245628$
280 ,, $\varepsilon_\sigma = 0{\cdot}254250.$

The distribution of the seven sets, and the total distribution, are shown in Table II. To take the latter first, I find for the whole 2080 observations

$$M = 22{\cdot}2712$$
$$\sigma = 6{\cdot}4301.$$

The mean therefore differs from expectation (22·5) by − 0·2288 or 1·625 times the standard error. The probability P of getting an equal or greater divergence of either sign on random sampling is 0·104, so the divergence is rather substantial.

For the standard deviation, on the other hand, the agreement with expectation is extraordinarily close: the difference from the expected value 6·4226 is only + 0·0075 or + 0·0804 times the standard error. The chance of an equal or greater divergence of either sign on random sampling is 0·936.

Turning now to the results for the separate sets, or sub-samples, the means with the differences from expectation are given in Table III. As might be expected from the mean for the aggregate of observations, the bulk of the means of sets, 5 out of 7, show a defect

TABLE III

Means of Sets, with Differences from Expectation, etc.

Set	Mean	Difference from Expectation	Divided by Standard Error	Square of Preceding Column
1	21·9100	− 0·5900	− 1·591	2·531
2	22·6600	+ 0·1600	+ 0·431	0·186
3	22·7633	+ 0·2633	+ 0·710	0·504
4	22·0267	− 0·4733	− 1·276	1·628
5	22·0900	− 0·4100	− 1·106	1·223
6	22·3200	− 0·1800	− 0·485	0·235
7	22·1179	− 0 4821	− 1·256	1·578
Total	—	—	—	7·885

below expectation; in 4 of the 7 sets the divergence from expectation exceeds the standard error, whereas one would only look for so great a divergence in 2 or 3 (viz. 2·2) instances. The sum of the squares of differences in terms of the standard error is shown at the foot of the last column, viz. 7·885. Entering the χ^2 table with this value of χ^2 and degrees of freedom $\nu = 7$ or Pearson's $n' = 8$, I find $P =$ 0·344; this is quite a high value, but how much weight can be attached to it with so odd a distribution of signs is a difficult question. For sets 4 to 7 alone, which give a continuous run of negative divergences, $M = 22{\cdot}1390$, difference from expectation $- 0{\cdot}361$ or $1{\cdot}931\varepsilon_m$, $P = 0{\cdot}053$.

The standard deviations with their deviations from expectation are shown similarly in Table IV. There is nothing odd here in the run of signs, but it is remarkable that *all the divergences for the first five sets exceed the standard error.* Entering the χ^2 table with $\chi^2 =$ 11·581 from the last column, degrees of freedom $\nu = 7$ or $n' = 8$, I find $P = 0{\cdot}118$. If the first five sets are taken by themselves—and in many sampling experiments starting from the beginning of the tables one might never reach the pages covered by sets 6 and 7—$\chi^2 = 11{\cdot}469$, $\nu = 5$ or $n' = 6$, $P = 0{\cdot}044$ only, a result below the 0·05 level of significance.

TABLE IV

Standard Deviations of Sets, with Differences from Expectation, etc.

Set	Standard Deviation	Difference from Expectation	Divided by Standard Error	Square of Preceding Column
1	6·687	+ 0·264	+ 1·075	1·156
2	5·974	− 0·449	− 1·828	3·342
3	5·951	− 0·472	− 1·922	3·694
4	6·760	+ 0·337	+ 1·372	1·882
5	6·713	+ 0·290	+ 1·181	1·395
6	6·464	+ 0·041	+ 0·185	0·034
7	6·352	− 0·071	− 0·279	0·078
Total	—	—	—	11·581

Since the distribution of Table I is symmetrical, errors in mean and standard deviation should be uncorrelated. Hence we may add corresponding figures in the last columns of Tables III and IV and apply the χ^2 method for means and standard deviations together. The total χ^2 is 19·466, $\nu = 14$, $n' = 15$, $P = 0{\cdot}149$, a rather higher value than for the standard deviations by themselves. No single set, it may be noted, is very improbable on the basis of mean and standard deviation together: adding corresponding figures in the last columns of Tables III and IV, the greatest total is given by set 3, viz. 4·198, which ($n' = 3$) gives $P = 0·125$. Since errors in mean and standard deviation *should* be uncorrelated, it is curious that every sign in Table IV is the opposite of that in Table III except for set 7; but this can hardly be anything but a chance result.

While no one of the preceding results leads to a *highly* improbable divergence from the expectation on random sampling, some of the values of P are not as high as could be wished, and Table IV appears to confirm the impression of "patchiness," especially in the earlier part of the Tables, which alone I had been using.

EFFECT OF GOLD PRICE CHANGES UPON PRICES FOR OTHER COMMODITIES

By GEORGE JACKSON EDER

IN hearings before the United States Court of Claims, in the case of Argonaut Mining Co., Ltd., *vs.* the U.S.A., the writer of this article was called as a monetary expert to prove that the depreciation of the dollar (or rise in the price of gold) from March 1933 to February 1934 "did produce, and must inevitably have produced, a rise in domestic prices for other commodities."

Doubtless any trained economist, whatever his monetary views, would accept this as axiomatic and regard proof as superfluous, but to satisfy the requirements of the Court it was necessary to "prove beyond all reasonable doubt . . . that the rise in prices following the rise in the price of gold . . . was not merely a fortuitous chronological sequence . . . but a necessary and inevitable consequence thereof." To prove this it was essential to clarify the theory and mechanics of gold and price relationships and to present unchallengeable statistical proof thereof sufficient to satisfy the critical examination of the Supreme Court. The material compiled throws some new light on price trends in that period, and should be of general interest to the statistical and economic as well as to the legal professions.

Measuring Dollar Depreciation

It was necessary, of course, to follow some consistent method of measuring the price of gold, as "official" Treasury prices were available on only 64 days during the entire period. Hence, the usual method of computing "gold prices in the United States," based on London or Paris gold prices multiplied by the foreign exchange rate, was employed, and it was found that the United States Government gold prices at no time varied by more than 4⅓ per cent. from the computed price based on London. The trend was identical; the average difference between the "official" price and the computed price for the 64 days on which "official" prices were quoted was less than one-half of 1 per cent. (0·465 per cent.). As between London and Paris, the difference in no month averaged more than 0·9 per cent.

It was shown that this close relationship between the price of gold in New York, London and Paris was inevitable, owing to the narrow spread between the "gold points" resulting from relatively low shipping and insurance charges (0·845 per cent. of the value of gold at the time), and, therefore, that a change in the United States value of gold produced an automatic change in the value of the dollar in the foreign exchanges, barring or allowing for changes in other currencies. The exposition of theory and statistical proof follows :—

Mechanics of Price Relationships

The relationship between a change in the gold value of a currency and the price, measured in that currency, of a given commodity is simple. For example, cotton may be chosen, this being one of the few major United States commodities which enters freely into international trade virtually unburdened by effective tariffs, quotas, or other barriers which would complicate the price and gold relationships.

Let us assume that, on a given date, the world price for cotton is 4 pence in Liverpool, or, say, 1 franc in Havre, and that this represents 6 cents in United States currency, as was approximately the case in March 1933. Assume then that the price of gold in the United States is increased overnight by 50 per cent. The world cotton price would still be 4 pence or 1 franc (there being no overnight change in the world supply or demand for cotton nor in the position of the franc or pound). The American exporter, however, when he cashed his 4 pence or 1 franc, would receive 9 cents instead of 6 cents as formerly, for the foreign exchange rates must respond immediately, as stated above, to changes in the currency. Hence, the domestic price for all cotton in the United States, whether exported or not, will be 9 cents, for, obviously, sellers will sell only in the best markets. The adjustment is purely a matter of arithmetic, and the rise in world staple commodity prices resulting from an increase in the dollar price for gold clearly does not depend upon speculation, nor upon the volume of monetary circulation, nor upon anything more complicated than simple multiplication.

That this simple exposition of theory works out fully in practice is demonstrated by Chart I opposite.

In the first section of this chart are plotted actual prices for cotton in Liverpool, Havre, Bremen and New York in terms of percentages of the March 1933 prices in those markets; also the price of gold in New York, based on Paris, in per cent. of the pre-depreciation parity. It will be seen that the English, French and German prices for cotton, in terms of gold, go up and down in virtual unison, following the changing world demand and supply for that commodity. The American price for cotton, however, rises sharply with the increase in the dollar price of gold, and by February 1934 has jumped from 6·3 cents to 12·1 cents a pound, while in the other markets there has been an average increase of only 10·8 per cent. However, it will be noted that, despite the

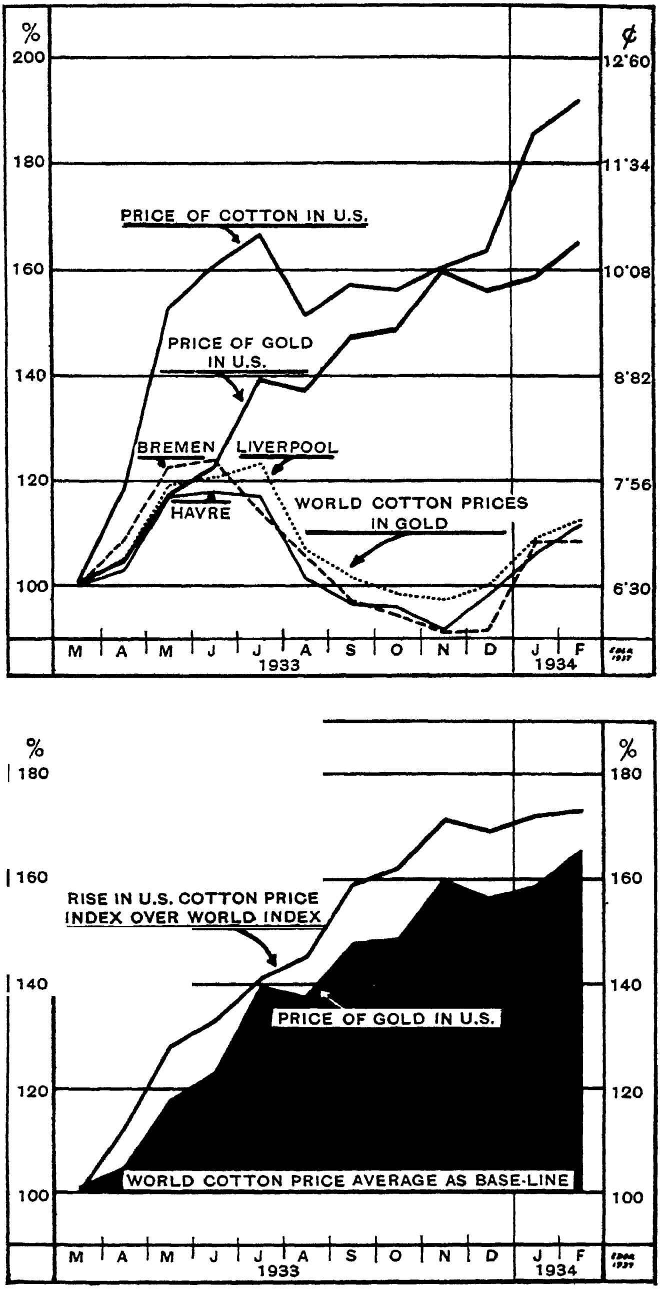

CHART I.—Effect of Gold Price Change on Cotton Prices.

precipitate jump in New York cotton prices, the New York market has also followed the same ups and downs as the world market; *i.e.*, it has been subject to the same world-wide influences of supply and demand as elsewhere.

The difference between the New York and the European trend has been due to the injection of a new factor, the increasing price of gold in the United States during the period, and that influence is brought out in the second section of the chart. There, the average of the Liverpool, Havre and Bremen prices has been taken as a base, while the fluctuating trend line shows the increase in the New York cotton price index over and above the world price index. The close correlation between the line indicating that trend and the line representing the index of dollar prices for gold demonstrates that the 69·3 per cent. rise in the dollar price of gold is responsible for the commensurate (73 per cent.) rise in American cotton prices over and above world cotton prices.

If this proof were valid for cotton alone, it might be open to question, but that it holds good for all world staple commodities is shown by Chart II opposite.

Here again, as in Chart I, the data are taken from the official French statistical bulletin, first, because France was at that time the most important nation still adhering to the gold standard, and, second, because the French statistics are the only convenient single source where quotations for a wide range of commodities in the leading world markets are available, it being inadvisable to use separate sources in view of the danger of disparity between commodity grades in the various national statistics.

The choice of commodities in Chart II has not been limited with a view to selecting only those commodities which might lend support to any special theory. Every international staple commodity, contained in Chart III and defined in the discussion under that chart, for which comparable European and American price series were available in the *Bulletin de la Statistique Générale de la France*, was used. In brief, the above Chart comprises 66·5 per cent., by value, of the international staple commodities contained in the Bureau of Labour Statistics Index of 784 wholesale commodity prices, and is therefore sufficiently representative to set aside any possibility of conscious or unconscious bias.

From Chart II it will be seen that European prices for certain of these commodities have risen, while others have fallen, each commodity being subject to the natural laws of supply and demand affecting that particular commodity during the period from March 1933 to February 1934. Price changes in the United States likewise show considerable divergence, from a gain of 33·3 per cent. in

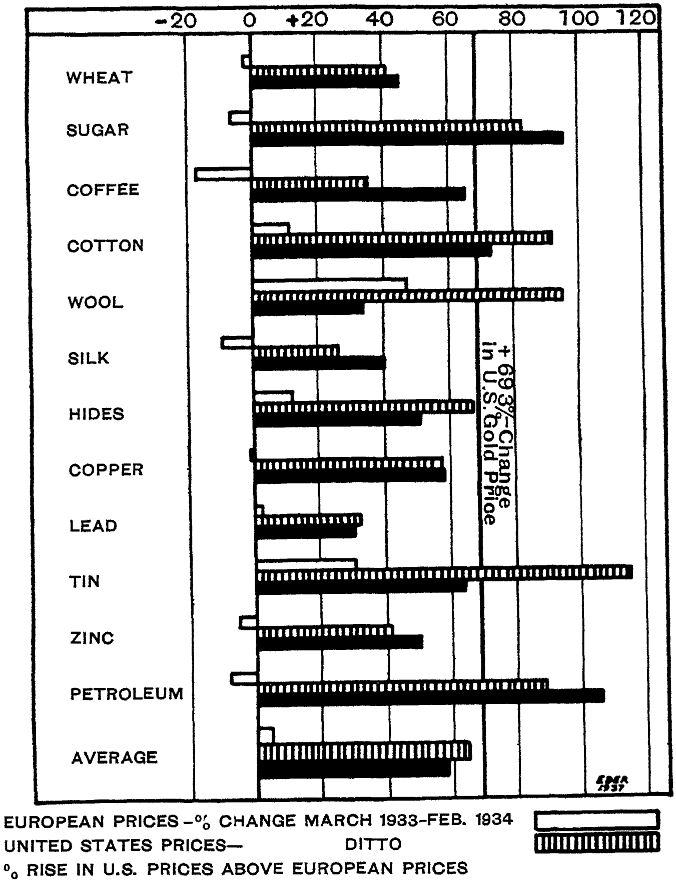

CHART II.—Gold Price Change and Commodity Prices.

the case of lead to one of 114·7 per cent. in the case of tin. In every case, however, the American price has risen substantially more than the European price. The average of the European price increases for all twelve commodities was only 4 per cent.; the average increase for the same commodities in the United States was 64 per cent. In other words, the American price index rose 58 per cent. more than the European index in the period from March 1933 to February 1934. The correlation, while not as perfect as in the case of cotton, owing to tariffs, quotas and other trade restrictions, fully corroborates the general theory that a rise in the dollar price of gold necessarily produces an automatic and approximately commensurate rise in dollar prices for other world staple commodities over and above price changes in other countries.

This concludes the presentation and proof of the theory of commodity price and gold price relationships.

Effect on Wholesale Prices in General

The actual course of prices in the United States, aside from international price comparisons, may be determined by study of the Bureau of Labour Statistics Index of Wholesale Commodity Prices, comprising 784 separate items. There are certain shortcomings in that index; nevertheless, its selection offers assurance against any bias in the choice of commodities.

First, however, it was considered legitimate to eliminate the 204 least important (in value) of the 784 quotations used by the B.L.S., inasmuch as this operation sacrificed only 7·02 per cent. of the total value. Duplicate quotations were then discarded, *e.g.* by using only a single quotation for wheat (the most important grade in each case) instead of six, etc., having first verified that over this period of time the single quotation gave an accurate indication of the trend. In a few cases general categories were employed, such as " boots and shoes," inasmuch as this study concerns price relationships rather than individual prices. These eliminations made it possible to cover 92·98 per cent. of the total value of the items comprised in the B.L.S. index (on a 1926 basis), with only 125 series of price quotations.

Finally, for purposes of study, the remaining commodities were divided into two major groups, Staples and Non-Staples, inasmuch as it will be found that prices for Staple and Non-Staple goods are affected by monetary forces in an entirely different manner, the difference being not merely one of degree, but frequently of direction as well. The Staple Commodities are subdivided, for convenience, into Domestic and World Staples.*

* To provide what is, as far as possible, an objective classification of these groups, the following definitions were used :—

The World Staples are commodities traded in the world staple markets (New York, London, Hamburg, Paris, etc.) on the basis of standard grades, or staples. They are either major imports or exports of the United States (over $10,000,000 normal per annum), or their export-import value comprises more than 10 per cent. of United States production or consumption according to the United States Tariff Commission study of February 1933 (Senate Document No. 180).

The Domestic Staples are traded in domestic staple markets on the basis of standard grades, or staples, but the American products are not generally quoted on London, Paris, or other world commodity exchanges because of their perishable nature, high tariffs or freights, or other reasons. Their export-import values comprise less than 1 per cent. of total United States production or consumption, according to the United States Tariff Commission study.

The Non-Staples, which may or may not be important in international trade, are commodities prices for which are computed by the producer on a cost-accounting basis and not fixed for him, willy-nilly, by the free interplay of market forces, as in the case of staple commodities. Some of these commodities are staples in the commercial sense of the word, but the trade will nevertheless agree that their prices are controlled by costs (excepting in

In classifying the commodities into the three above-mentioned categories, it was found necessary to reject 29 items of uncertain or varying category, these totalling exactly 22 per cent. of the total B.L.S. value. Thus, the final selection, made by impartial norms, is representative of 70·98 per cent., by value, of the total commodities listed in the B.L.S. index.

The statistical material thus compiled is presented in Chart III below, which compares commodity price fluctuations with the monthly variations in the dollar price of gold (based upon New York prices for French franc exchange) :—

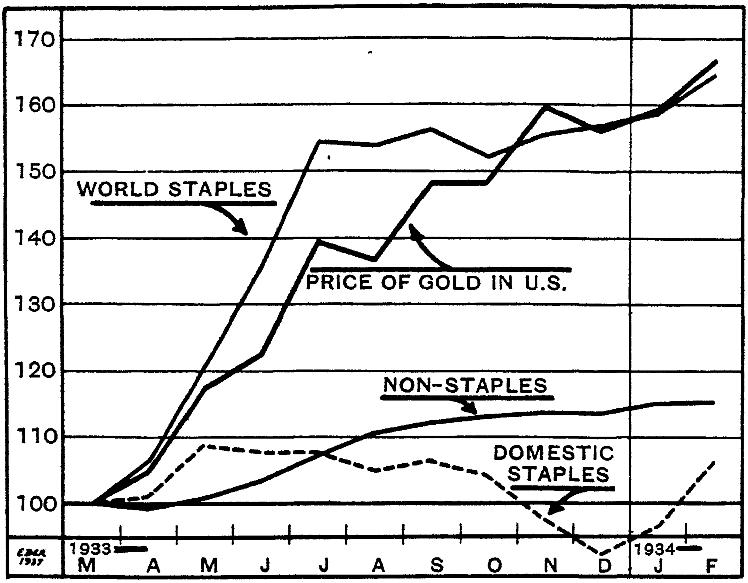

Chart III.—Effect of Gold Price Change on Commodity Prices.

From this chart it will be seen that, from March 1933 to February 1934, when the dollar price of gold was raised approximately 69 per cent., the World Staple Commodities rose exactly 64·2 per cent.

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abnormal times in the case of distress merchandise), and not by uncontrolled supply and demand. For the most part, however, the commodities in this group are not traded as staples (that is, by grades and standards alone), but on the basis of brand names, reputation, service, and other non-staple qualities. The term "Non-staple commodities" is not a satisfactory designation, but is here used, *faute de mieux*. "Fabricated" or "Manufactured Goods" would be the most convenient appellation, for that is largely what they are; but that would entail a dispute as to why steel rails are classed as manufactured, and not crude rubber or raw sugar. The exact definition is : "Commodities whose prices are normally computed by the producer on a cost basis," of which subject more anon. Inasmuch as prices are fixed by the producer, it is of no moment whether they are sold here or abroad, and so no division into domestic and international commodities is requisite, or, for that matter, possible.

in price, while prices for the Domestic Staple Commodities rose 6·6 per cent., and prices for the Non-Staple Commodities 15·1 per cent.

Examining the component series, it is found that every one of the World Staple Commodities rose at least 20 per cent. in price during this period, while in the case of the strictly Domestic Staples, 8 out of the 12 quotations used failed to rise 20 per cent., and 3 actually dropped, indicating no relationship whatsoever with the price of gold. In the third category, the Manufactured and other Non-Staple Goods, 45 out of the 63 commodities failed to show a 20 per cent. rise, 10 actually dropping in price, and 6 remaining absolutely stationary throughout the period. In other words, there is no immediately apparent relationship between prices for these non-staple goods and changes in the price of gold.

From the analysis of price relationships presented in the examples of cotton and other commodities above, the fact that prices for the World Staple Commodities rose in this market by some 64 per cent. when the dollar price of gold was raised 69·3 per cent. would seem to indicate that world commodity prices, in terms of gold, must have remained virtually stable from March 1933 to February 1934. The fact is that wholesale commodity price indexes in the "Gold Bloc" countries varied only 0·1 per cent. during the period, and experience shows that variations in world staple prices are never more than 6 to 9 times greater than variations in wholesale prices in general, so that this showing would connote a maximum fluctuation of 1 per cent. in World Staple Commodity prices in the "Gold Bloc" countries.

Wholesale Price Indexes in per cent. of 1929 *Base*

(Data from League of Nations *Statistical Yearbook of* 1935–36 and *Monthly Bulletins of Statistics* for May 1934 and January 1935)

	March 1933	February 1934
Belgium	59·2	56·9
France	62·2	63·8
Italy	67·0	65·0
Netherlands	60·8	65·5
Poland	62·1	59·8
Switzerland	63·7	64·7
Average	62·5	62·6

During this period there were, of course, many opposing supply and demand factors in operation throughout the world, but, as is shown, these forces completely neutralised one another, and it would be otiose to analyse them; the net result was to leave prices absolutely stable in the gold standard countries, and hence the rise in world staple prices in the United States must be attributed to the 69 per cent. rise in the dollar price of gold, quite in accordance with the preceding exposition and demonstration of theory.

In sum, prices for World Staple Commodities everywhere must be, and are, virtually identical, measured in terms of gold. Tariffs, freights, and other costs, or barriers to trade, may create a fixed differential between domestic and international prices, and to that extent may cushion world price pressures, but on the whole, as has been demonstrated, prices for World Staple Commodities in one country, in terms of gold, vary precisely with prices for the same commodities in other markets, and thus any change in the gold value of one currency must produce a corresponding change in prices as compared with prices abroad.

Obviously, these international forces cannot be felt directly upon purely Domestic Commodities, not entering into world trade, or ensconced behind tariff or natural barriers. Indirectly, they will be felt in time, for, clearly, if a farmer can get more money by producing the international commodities, he will soon cease to produce the domestic staples until prices are once more in line. The world staples are thus the leaven whereby all prices are eventually raised, first, because they compete in production with the Domestic Staples, and, second, because they enter very largely into the cost of the manufactured products.

Distinction between Staples and Non-Staples

Finally, to conclude the presentation of price-gold relationships, it must be determined why it is that Non-Staple (chiefly manufactured) goods have shown so little correlation with changes in the dollar price of gold.

In the first place, there is a fundamental practical difference between prices for Staple Commodities (whether domestic or international) and prices for manufactured goods. Prices for the former are the pure result of untrammelled supply and demand. Production costs play no part in the market price at any given time. The producer does not fix his price : it is fixed for him by the buyer on the relentless auction block of the market-place. In the case of the farmer, he is powerless even to control his production, and is forced to dump upon the market, at the buyer's price, the abundance or the little that the hazard of the elements has produced for him, quite regardless of the production costs of land, labour, interest, tools, seed and fertilizer.

Completely manufactured goods, ready for the consumer, on the other hand, have their prices fixed by an entirely different system. The manufacturer *computes* his costs, makes an allowance for overhead, profits, etc., and affixes his own price tag. He has full control of his own supply, and, as he is selling partly on non-staple qualities, through advertising a brand or trade mark, or through "servicing," etc., he is to some extent free from cut-throat competition, except in abnormal times. He may, of course, lose money by overestimating his market or because he is less efficient in manufacturing or distribution than his competitors, but, so far as the element of price is concerned, he "writes his own ticket." It is only in times of crisis that distress merchandise reaches the consumer at less than cost, except for seasonal clearances, etc.

Some distinction may be made between "consumer" goods and others. It is a question of the nature of the buyer. The automobile, typewriter, and electric refrigerator are good examples of typical consumer manufactures for which the prices are fixed strictly by the manufacturer, subject only to the limitations of competition from other manufacturers who figure their costs in a like manner. Shoe findings and unbleached cotton goods are examples of products in which the buyer plays some part at least in determining the price, but even here there is always the paramount limitation of cost of production. Thousands of articles fall midway between the poles of staple goods for which prices are fixed by the buyer and consumer goods for which prices are fixed by the seller. Nevertheless, it is clear that the "computed" prices for manufactured goods, whether consumers' goods or semi-manufactures, are an entirely different economic phenomenon from the market prices for the basic staples. They are not really "market prices," and it would be desirable if some term other than "price" were applied to them; they are actually, except in the case of distress sales, "cost plus profit," representing the cost of raw materials, plus wages, overhead, interest, profits and so forth. It may be argued that the difference is merely one of degree—of the relative bargaining powers of farmers, manufacturers, housewives and merchants—but the difference between hot and cold, men and women, cats and lions is likewise merely one of degree; actually "market prices" and "computed prices" are entirely different animals, and to group them together in a single index is productive of much confusion.

These computed prices do not even follow the same economic laws as do the true market prices. The economic forces which cause market prices to rise might well cause computed prices to drop, depending on the nature of the product. With farm products and other staples a sudden increase in volume demand inevitably means higher prices, because the supply cannot be immediately increased, and, even over the longer term, the increased output will in general cost more because of the law of diminishing returns. With manufactured goods, however, there is no reasonable limit to the potential supply, and if the automobile manufacturers who are prepared to put out five million cars this year were suddenly confronted with a demand for six million cars, the reduction in overhead would be so great that prices might well be substantially reduced at no loss to profits. Thus, the very factor—volume demand—which operates to bring about higher prices in the case of raw materials may bring lower prices in the case of manufactured goods.

There is an interesting example of this phenomenon in the case of the Dupont Cellophane Co., which in the past eleven years has cut the price of its product 18 times, to a total slash of 86 per cent., owing entirely to the manufacturing economies made possible by the increased demand. Not all products are so situated, of course, but the great bulk of manufactured goods included in the B.L.S. index are products which are susceptible of great economies in production costs in the event of an increased volume demand, and thus it is entirely possible that raising the price of gold, which raises the price of world staple commodities, might under certain conditions bring about lower prices for manufactured goods and for the B.L.S. index as a whole. Economists who attempt to analyse the effects of monetary action by using unadjusted wholesale, cost-of-living or general prices indexes simply betray their ignorance of actual market conditions.

For the March 1933–February 1934 period it is relatively simple to show that the rise in the entire Bureau of Labour Statistics Index of Wholesale Commodity Prices was caused very largely by the increase in the dollar price of gold. In the first place, the 1933 Census of Manufactures shows that, in the completed cost of all manufactured products, wages account for 16·8 per cent., salaries 4·3 per cent., overhead, profits, etc., 25·3 per cent., and materials 53·6 per cent. It would be difficult to determine precisely what proportion of these " materials " are raw materials or semi-manufactures, but, of the raw materials, some 85 per cent. consist of the world staple commodities, judging by the B.L.S. series, and it would be reasonable to assume, for the sake of analysis, that about 20 per cent. of the value of the non-staples is made up of world staple materials.

Thus, out of the entire Bureau of Labour Statistics, 784 commodities, it may be admitted that the Domestic Staples, comprising some 17·3 per cent. of the total value (based on the 71 per cent. sample taken), were scarcely affected, if at all, by the gold price increase. However, they advanced only 6·6 per cent. in the March 1933–February 1934 period. The World Staples, comprising some 21·3 per cent. of the total value included in the index, advanced 64·2 per cent. in that period, and this rise is shown to have been due entirely to the increase in the price of gold. The Non-Staples, including 61·4 per cent. of the B.L.S. series, rose 15·1 per cent., and, in their price structure, the World Staple materials component rose 64 per cent., so that it is clear that these materials must have accounted for a very considerable part of their total rise. The following chart will clarify this breakdown:—

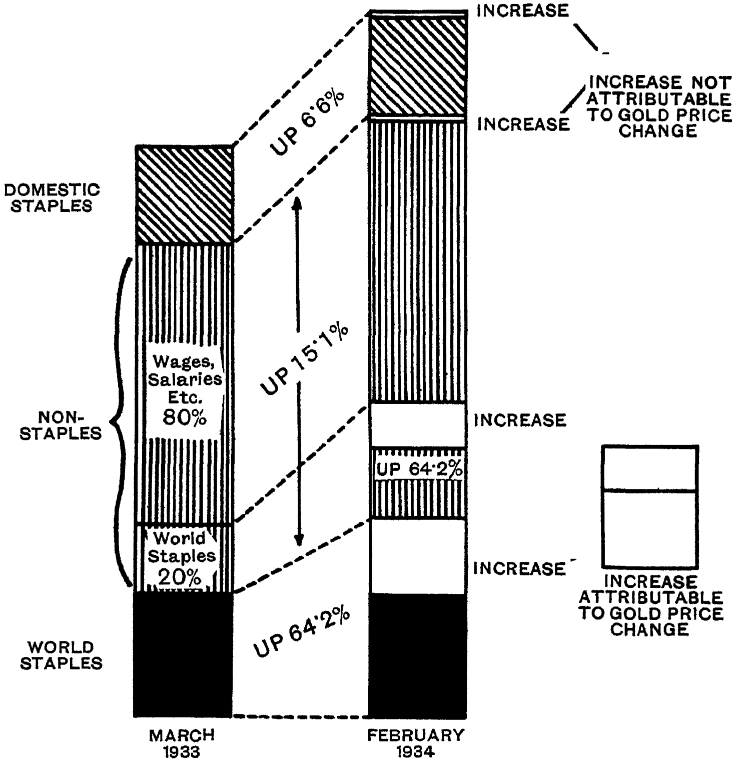

CHART IV.—Changing Composition of B.L.S. Wholesale Price Index {March 1933 / February 1934

	Per cent. of Total		Price Index		February 1934 Relatives	INCREASE Due to Gold Price Rise	Due to Other Causes
World Staples	21·3	×	164·2	=	34·9	13·6	—
Domestic Staples ...	17·3	×	106·6	=	18·4	—	1·1
Non-Staples	61·4	×	115·1	=	70·6	—	—
{ World Staples ...	12·3	×	164·2	=	20·2	7·9	—
{ Wages, salaries, etc....	49·1	×	—	=	50·4	—	1·3
	100·0				123·9	21·5	2·4

In brief, it is probable that some 21 per cent. of the 23 per cent. rise in the Bureau of Labour Statistics Wholesale Price Index can be attributed to the increase in the price of gold. (N.B.—The actual rise was 22·3 per cent., the slight discrepancy being due to the fact that only a 71 per cent. sample was used in the calculation.)

Corroborative Experience in Other Countries

This concludes the examination of commodity price fluctuations in the United States arising out of the increase in the price of gold between March 1933 and February 1934. As a scientific control, however, it is necessary to examine briefly the effect of monetary devaluation in other countries upon their local price structures, for clearly if the same causes fail to produce the same results wherever applied, there must be a flaw in the reasoning processes.

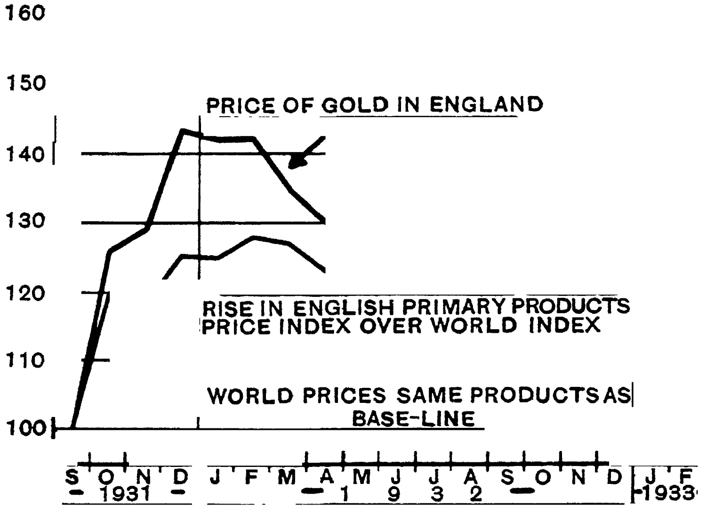

Chart V.—Effect of English Gold Price Change on Prices.

The best example is that of England, which abandoned the gold standard on September 21, 1931, allowing the pound sterling to depreciate some 30 per cent. over a period of 18 months before the United States took similar action. The problem here is simplified by the existence of the Bank of England Price Index of Primary Products, which gives sterling prices in England and dollar prices in the United States for fifteen virtually identical commodities (wheat, corn, sugar, bacon, tea (United Kingdom), coffee (United States), copper, iron, lead, silver, tin, cotton, hides, linseed, rubber, wool).

In Chart V above, the price index for these 15 primary products in the United States (in gold dollars) is taken as a base line (100). The trend lines therefore represent: (1) percentage changes in the British price index with relation to world price levels for the same commodities, and (2) percentage changes in the price of gold in London.

United States prices for these commodities dropped 22·6 per cent. from September 1931 to February 1934; in other words, the world price trend in terms of gold standard currencies was downward. In England, however, the 15 primary commodities rose 7·0 per cent. Compared with prices in the United States, the British primary price level advanced 38 per cent. during the period that the price of gold in London was raised 42 per cent.

This correlation confirms the conclusions reached with regard to gold price changes in the United States. Moreover, if the index were constructed of identical commodities without the substitution of coffee for tea in the American index, there would have been a more accurate correlation, which is remarkable when tariffs and other barriers to free commercial intercourse are considered. Furthermore, it may be stated that every one of the component products shows a closer correlation than the index as a whole, with the exception of the coffee and tea prices, which have set the whole index to some extent askew. This factor, together with tariff differentials, etc., on a few other items, accounts for the entire interim gap between the two lines.

Prices in the remainder of the " Sterling Area " behaved in precisely the same way. Sweden, for example, abandoned the gold standard on September 26, 1931, allowing the krona to drop 30 per cent. between then and February 1933 (Standard Statistics monthly average of daily quotations). As a consequence, the Swedish Board of Trade Index of Raw Material Prices (taken from *Quarterly Report of Skandinaviska Kreditaktiebolaget*, July 1933) rose 5·94 per cent. from September 1931 to February 1933. Meanwhile, Primary Products in the United States (the index used in the British price comparison over the same period) dropped 22·6 per cent. In other words, Swedish raw material prices rose 37 per cent. over and above world price levels, measured in the major gold standard country. The 30 per cent. drop in the krona represented a 43 per cent. increase in the Swedish price of gold, again proving that an increase in the price of gold necessarily produces a corresponding increase in prices for other commodities. The same proof could be given in the cases of Finland, Denmark, Norway, Argentina and other lesser nations composing the so-called " Sterling Area."

Following devaluation by the United States, the next major defection from the " Gold Bloc " was Belgium, which, under Royal

Decree of March 31, 1935, devalued the Belga by 28 per cent., signifying a 39 per cent. increase in the price of gold. As a result, raw material prices in Belgium rose 54·3 per cent. in 1935 compared with 1934, while in the United States they advanced only 2·0 per cent., and in England 11·3 per cent., a clear gain for Belgian prices, over and above the Anglo-American average level, of 45 per cent. (data from *World Production and Prices 1935–36*, League of Nations, p. 115).

Finally, on September 25, 1936, France and the remaining nations in the " Gold Bloc " likewise abandoned the gold standard, and the French franc was allowed to drop 30·2 per cent. from August 1936 to March 1937 (Standard Statistics monthly average of daily quotations), corresponding to a 43 per cent. rise in the price of gold. The French official Index of Industrial Material Prices rose 50·3 per cent. during the same seven-month period (*Bulletin de la Statistique Générale de la France, Supplément Mensuel*, January and April 1937). In that time the United States Bureau of Labour Statistics Index of Raw Material Prices advanced 10·55 per cent., meaning that French raw material prices rose 36 per cent. more than similar commodity prices in the major gold standard market.

Conclusions

In sum, it is demonstrated: " (1) that prices rose from March 1933 to February 1934, not merely as a result of a fortuitous chronological sequence following the increase in the price of gold, but as a necessary and inevitable consequence thereof; (2) that an increase in the price of gold, however, wherever and whenever this may occur, automatically produces an immediate and corresponding increase in prices for other world staple commodities over and above world prices for those same commodities, measured in terms of gold; and (3) that, by reason of the importance of these said world staple commodities in the manufacture of other goods and in the composition of commodity prices indexes, such an increase in the price of gold will also necessarily and inevitably result in an increase in the general level of prices of all other commodities taken together, over and above the levels that would have existed had it not been for the said rise in the price of gold."

THE IRISH CENSUS OF DISTRIBUTION

By PROFESSOR B. F. SHIELDS, M.A., D.Econ.Sc.

[Some preliminary information relating to the Irish Census of Distribution was given by Mr. J. C. M. Eason in course of the discussion on Miss Iris Douglas's paper "Retail Trade Statistics in Different Countries" published in the *Journal* for 1935 (Vol. 98, *see* p. 484), and the operative part of the Schedule was reproduced at the end of the Report (*loc. cit.*, p. 493). These form an introduction to the following paper, which consists of the major part of the discourse given by Professor Shields to Section F of the British Association in September 1937, and surveys the results of the Census.—ED.]

Objects of the Census

THE main object of the Irish Census of Distribution for the year 1933, as indicated by the questionnaire forms to be filled in by retailers and wholesalers, was to obtain the following particulars of their businesses: the approximate date of its original establishment; the approximate date when it came under present ownership; whether the business was under national or non-national control; the kind of business carried on, and if it were a single independent establishment or one of a number under the same proprietorship; the number of persons engaged divided into working proprietors, members of the proprietor's family and others employed in the business; the total wages, salaries and commissions paid during the year, and the average number of persons to whom such wages, etc., were paid; the separate totals of wholesale and retail sales and of services rendered; the amount of rent (including rates); and the value of stocks at the end of the years 1932 and 1933. There was no attempt to ascertain gross or net profit in any business or group of businesses.

The only questions there was any difficulty in answering were those on the date of the original establishment and rent paid, the data of which could not be used on account of the inadequacy of the answers given. As the majority of the small retail firms do not keep systematic accounts, estimates, in most cases probably underestimates, of the required figures, especially of sales, were submitted. If paid canvassers or enumerators had been employed to visit each shop and obtain the requisite information, more complete and reliable figures would have been obtained in the case of the smaller concerns. It may be suggested that if particulars were procured of the number of male and female young persons and adults, part- and whole-time employees, separate figures of those engaged on the selling and delivery sides, lists of scheduled commodities or groups of commodities sold by various types of shops, and the type of business control, such as individual proprietorships, partnerships, private and public joint-stock companies, co-operative shops (few in number), additional useful information would have been available on retail trading in the country. In a complete census of wholesale trading, sales of commodities or grouped commodities might also be required.

Comparison with Canada and United States

A brief comparison between the procedure in compiling the Canadian, United States and Irish Censuses of Distribution should prove interesting.

The Canadian Census was taken for the year 1930, and included all establishments engaged in retail and wholesale trade and services. The last word was used more broadly than is usual, and embraced amusement, recreational, educational, repair, cartage, motor transport, and other retail service establishments operated for gain. 24 different types of schedules were employed: 10 for retail trade, 1 for services, 6 for wholesale trade and 7 for miscellaneous purposes. The following information, not required in the Irish, was asked for in the Canadian Census: the number of whole- and part-time employees employed in the middle of five specified months and the total pay-roll of part-time employees; the approximate amount of net sales, divided into cash, credit, instalment, mail-order, sales to other retailers, of goods manufactured on the premises; the total capital (cash, buildings, goods, etc.) employed or invested in the business; whether the business was a joint-stock company; the total of all expenses other than wages, salaries, rent, and cost of goods purchased for re-sale. The annual sales of appropriate scheduled commodities had to be given by the larger types of business —that is, those with a turnover of over $25,000. Although only one complete Census has been taken in Canada, annual surveys are made, for which returns are secured from all the larger stores and are used in arriving at the trend of business from year to year.

The United States have now completed three Censuses of Distribution (called Business) for the years 1928, 1933, and 1935, which were designed to cover, with a few exceptions, all non-agricultural and non-manufacturing establishments in the country. The 1935 census was taken simultaneously with the biennial Census of Manufactures. Unlike the Irish and Canadian censuses, enumerators obtained the requisite information by oral enquiry or left the schedules to be filled in by the proprietors and collected later. In addition to those referred to in the Irish census, the following questions, *inter alia*, were asked: race of owner; legal form of organization; total operating expenses other than pay-roll; number of proprietors and firm members devoting a major part of their time to the business; the number and pay-roll of part-time employees; the number of paid employees engaged about the middle of each month in the year; the number of paid employees classified by type of duties performed, a distinction being made between those having supervisory or administrative responsibilities, office and clerical workers, and others engaged in selling and delivery services. Retail establishments selling groceries and other goods and having an annual turnover of less than $50,000, in which grocery sales formed at least 25 per cent. of the total, were required to give the values of commodities sold, according to seven main specified divisions, and all establishments with a turnover of less than $50,000 were asked to indicate by a check mark on a scheduled list the commodities sold in their store. An elaborate analysis of total sales of individual commodities was necessary in the case of the larger stores.

The Irish Census

The questionnaire forms of 37,628, or 82 per cent. of the 45,888 retail establishments, listed by the Garda, were used for the compilation of the official tables relating to retail trading. In addition, 1,419 returns from wholesalers, manufacturers' agents, etc., were found useful for statistical analysis. The only other previous data on the subject were the estimate of about 42,500 shops in the country made by the Tribunal on Prices, 1927, and the figures in the Census of Population, 1926, of 37,043 employers and persons working on their own account in the wholesale and retail trade within the classification of the Census of Distribution. According to the latter, the number of working proprietors was 37,941. The former figure (37,043) does not include companies or businesses owned by individuals whose principal occupation was other than shop-keeping.

The classification of shops presented great difficulties, as retail concerns trading in single well-defined lines of goods are exceptional. As a result the individual headings of the descriptions of businesses are not mutually exclusive, which may be noted in the headings: "Grocery and Provisions," "Grocery and Public-houses," and "Public-houses," while general shops may sell foodstuffs, drink, tobacco, sweets, hardware, etc. The original list of 34 classifications was reduced to 20, as the number of firms in some of the descriptions was so low in certain areas and the value of the sale returns appeared dubious. A further reduction to 13 was made for data in connection with counties and large towns.

Number of Shops.—There are approximately 46,000 shops in the country, or 1 shop to every 65 persons, or to about 20 families. In Dublin City there is 1 shop to every 68 persons, and in the other county boroughs: Cork, 1 to 35; Limerick, 1 to 37; Dun Laoghaire, an outpost of Dublin, 1 to 70; Waterford, 1 to 43; while in the counties the ratio varies between 1 to 50 in Cork to 1 to 87 in Meath.

Types of Shops.—92·9 per cent. of the total number of shops are single independents, with a turnover equivalent to 79·2 per cent. of the total sales, while the remainder, 7·1 per cent., are multiple shops, transacting 20·8 per cent. of the total trade. 10 per cent. of the multiple shops, handling 3·8 per cent. of the retail sales, are controlled by non-nationals. The latter control 1·1 per cent. of the retail shops and transact 5·6 per cent. of the total business.

Shops are classified in the Census according to the chief lines of goods sold, which obscures the fact that most of them, especially in country districts, carry on trade in commodities other than those related to their popular designation, while general shops are included in the Census tables under the heading, "other and general shops," the latter being 6·3 per cent. of the total number. The main business of two-thirds of the shops is food and drink, one-fourteenth of them are for the most part engaged in selling drapery goods, while the principal business of one-twelfth is in sweets, tobacco and newspapers. It is interesting to note in this connection that 30,000 licences have been issued for the sale of tobacco and cigarettes throughout the country.

Size of Shops.—The preponderance of the small retailer is evident from the fact that two-thirds of the shops, with an output of only 13·5 per cent. of total sales, have an annual turnover of less than £1,000, and 48·6 per cent. of these have individual sales of less than £500 per annum, and an aggregate turnover of about 6 per cent. of the total trade. There are only 50 shops, or 1 per cent. of the total, doing an annual trade of £50,000 or more. Of these 33 are located in Dublin and 8 in Cork. 24 of these shops are mainly engaged in selling drapery goods, 5 in grocery and provisions, 4 in the coal trade; cycles and automobiles, metals, metal goods, etc., hotels and restaurants account for 7, and other and general shops for 10. The median-size business in grocery and provisions, public-houses, sweets, tobacco and newspapers has a yearly turnover of between £100 and £500, in public-house and grocery, cycles and automobiles, fresh meat, jewellery, hotels and restaurants a yearly turnover of between £500 and £1,000 per annum, and in drapery, coal, chemists, metals and metal goods a yearly turnover of from £1,000 to £2,500.

Sales.—The aggregate of the retail sales included in the Census was slightly over £62½ million, or an annual expenditure of £21 per head of the population, or about 8*s*. per head per week. If the figures for the sales of 18 per cent. of the retail shops not included and those of other methods of sale to consumers were taken into account, the total sales would probably amount to between £65 and £70 million, or at most 9*s*. per head of the population per week. The sales per head varied in the provinces: in Leinster £28, omitting Dublin City £18, in Munster £20, in Connaught £12, and in the part of Ulster within the Saorstát* £12. 33·5 per cent. of the total sales was attributed to Dublin, 14 per cent. to the combined county boroughs of Cork, Limerick, Dun Laoghaire and Waterford, while 8 towns with a population of between 10,000 and 20,000 accounted for 7·5 per cent. Accordingly 45 per cent. of the retail business was transacted in towns with a population of less than 10,000, villages, and country districts. About 55 per cent. of the retail trade took place in shops whose main business was food and drink, which was practically the proportion borne by food and drink in the total expenditure of the sample of families the data from which were used for computing the official cost of living index number for August 1933, while about 16 per cent. was spent in drapery shops. Reference will be made later to the distribution of expenditure of the retail £ in various grouped areas in the country.

The average annual sales per shop amounted to £1,655. In Dublin City the average was £3,647, in the four other county boroughs, with a population of between 28,000 and 80,000, it varied between £2,073 and £2,581, in towns with a population of between 10,000 and 20,000 the average was £2,263, and for the rest of the country £1,092. The following businesses had the highest annual average turnover per shop: coal £4,641, "other and general" shops £3,704, metal goods £3,666, drapery £3,346, paper, stationery and books £3,227.

The sales per person engaged in all retail shops in the Saorstát amounted to £499, in Dublin £694, in the other four county boroughs ranged from £557 to £586; in 8 towns with a population between 10,000 and 20,000 the average was £591, and for the rest of the country £391. The businesses in which the sales per person engaged were highest were grain and forage £755, "other and general" shops £688, coal £652, metal goods £637, drapery £631.

Stock-Turnover.†—It is difficult to compute from the Census tables the number of times the average stock was turned over in the year, as the values of stock are given at cost price at the end of 1933. Allowing an all-round mark down of 20 per cent. off sales, the average number of times stock was turned over in the Saorstát was 4·6, in Dublin City 5·8, Dun Laoghaire (a seaside resort) 8·5,

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* This paper was in print before the name of the Irish State was changed to Éire.

† *Vide* Appendix C and notes thereto.

Cork 4·7, Bray (seaside) 6·5, in towns with a population of 10,000-20,000, except Bray, the combined average was 4·3, and in all counties having no town with a population more than 5,000 the average was 3·8.

Stocks were turned over 7·4 times in the year in the grocery and provision trade throughout the Saorstát, 5·8 times in shops in the £100–£500 class, and 8·2 times in the £10,000–£50,000 group, after which the figure was 3·9. The corresponding figure for public-houses was 6·4, the highest being 7·7 in the £500–£1,000 sales class, with a progressive decline in each higher group to 2·3 times in businesses with an annual trade of £10,000–£50,000. The average for all drapery concerns was 2·0, increasing from 1·1 in the lowest group, £100–£500, to 3·1 in firms with an annual sales of £50,000 and over. The average number of times jewellery stocks were turned over was once a year. The stock turnover rate for all chemists was 2·5, with little variation, 1·4 to 2·9 according to the size of the business. The rate in cycles and automobiles was 5·8 times a year, varying between 3·5 and 6·8. The corresponding figures for similar trades in Dublin were slightly greater, except in grocery and provisions, where they were much higher, being 11·2 for all businesses, and ranging between 7·7 and 15·6 in the lowest and second highest class groups, while in those doing an annual trade of over £10,000 stocks were turned over 8·4 times in the year.

The Human Element in Distribution

Individuals Engaged.—There were 124,799, 54·5 per cent. males and 45·5 per cent. females, engaged in the retail shops tabulated in the Census, equivalent to 4·2 per cent. of the total population, or 9·6 per cent. of these employed in occupations according to the Census of Population, 1926. This percentage distribution appears to be more or less uniform, within a range of 9 per cent. for all towns with a population of over 10,000. For instance, the figures for Dublin are 55·8 and 44·2 respectively, for Limerick 53·9 and 46·1, Waterford 56·5 and 43·5, Galway 55·2 and 44·8, Sligo 55·1 and 44·9, and Tralee 54·4 and 45·6. In Cork the normal relation of males and females in the retail trade is reversed, being 46·9 per cent. and 53·1 per cent. respectively. In this city 53 per cent. of the population is composed of females, certain important industries employ male labour, and an unduly large number of retail businesses absorb female workers. The relative proportion of males and females engaged in retail distribution, taking the aggregate of all districts with a population less than 10,000, is 54·5 per cent. and 45·5 per cent., the same as for the Saorstát.

The male element preponderated to the extent of 92 per cent. in the coal trade, 88 per cent. in automobiles and cycles, 77 per cent. in metal goods and in fresh meat, 76 per cent. in chemists and in jewellery, 72 per cent. in grain and forage, 67 per cent. in fish and dead poultry. On the other hand, females were more extensively employed in other directions: for instance, 69 per cent. in hotels and restaurants, and 65 per cent. in sweets, tobacco and newspapers.

Family Workers.—There is a fairly even division of employment between family and non-family labour in retail trade in the Saorstát, the percentage figures being: working proprietors 29·5, proprietors' family 22·3, making 51·8 per cent. for family labour, as against others employed 48·2 per cent. The corresponding percentage figures for Dublin City are 17·8, 10·3 and 71·9 respectively. In Saorstát businesses with a turnover of less than £50 per week family labour predominates, after which it decreases relatively to the total engaged and in the aggregate per shop, until businesses with an annual turnover of £50,000 and upwards are reached, in which family labour (0·2 per cent. of total engaged) is insignificant. Family labour is mostly employed in sweets, tobacco and newspapers (70 per cent. of total engaged), grocery and provisions, public-houses, vegetables and fruit (68 per cent.), public-house and grocery (61 per cent.), while the following businesses are conducted by non-family labour: coal (82 per cent.), hotels and restaurants, metal goods, drapery, cycles and automobiles, chemists and jewellery (60 per cent.).

Distribution of Retail Employment.—Of the total number of persons engaged in retail trade in the Saorstát, 25 per cent. are employed in grocery and provision shops, 13 per cent. in drapery, 12·8 per cent. in public-houses and grocery, 8·1 per cent. in public-houses, and 6·1 per cent. in hotels and restaurants. In Dublin City the largest employment is given in the following: drapery 18 per cent. of total, "other and general" shops 14·3 per cent., grocery and provisions 13·6 per cent., hotels and restaurants 9·4 per cent., sweets, tobacco and newspapers 6·6 per cent., public-houses 6·4 per cent.

Wages and Salaries.—The total wages and salaries paid to employees in retail shops in the Saorstát amounted to £5·86 million, which is equivalent to £83 per paid employee or 9·4 per cent. of sales. 40·5 per cent. of the total pay-roll was paid in businesses with an annual turnover of £10,000 and more, 17·3 per cent. each in those in the £2,500–£5,000 and £5,000–£10,000 classes, 15·6 per cent. in the £1,000–£2,500, and only 9·1 per cent. in businesses with a turnover less than £1,000.

Businesses paying the largest amounts of wages and salaries were: drapery (21 per cent. of total), grocery and provisions (15 per cent.), public-houses and grocery (8·5 per cent.), hotels and restaurants (6·2 per cent.). The average annual wage per person paid increases in a progressive scale from £40 in the £100-£500 turnover class, in which family labour is largely employed and for the most part not included in the wages pay-roll, to £130 in businesses with a turnover of £50,000 and upwards.

*Wages and Salaries as a Percentage of Sales.** – Taking the amounts given for total wages and salaries as a percentage of sales in each of the seven classified sizes of businesses, commencing with a turnover of £100–£500, and ending with £50,000 and more, the resultant figures increase progressively from 5·7 to 12·8 for the Saorstát. For Dublin the same progressive increase may be noticed, at about 2 per cent. higher levels, except that businesses with a turnover in the three groups between £1,000 and £10,000 have the same percentage 11·0. Similar conclusions are evident for the grouped size of combined businesses in towns with a population from 20,000 to 80,000. The explanation of these rather peculiar results—the larger the output the greater the percentage that the amount of wages and salaries bears to sales—is due to the fact that the smaller-size businesses are worked largely by family labour, and proprietors in filling up the census returns did not, for the most part, include as wages or salary payments made out of their business to themselves or to members of their families.

Importance of Dublin City

The population of Dublin, according to the Census, 1936, was 467,691, or 15·8 per cent. of the total for the Saorstát, a percentage increase of 15·7 per cent. on the figures for 1926. The percentage of males and females was 47 and 53 respectively. According to the Census of Distribution, 29·445 were engaged in retail trade, or 23·6 per cent. of the total in the Saorstát. Dublin shops transacted 33·5 per cent. of the entire trade and paid 42 per cent. of the total wages to 33⅓ per cent. of the wage-earners employed in retail distribution in the Saorstát. The average wage paid was £105·2. It is interesting to note that the sales in Dublin shops represented high percentages of the total sales in the Saorstát: thus fresh meat accounted for 57 per cent. of the total sold in the whole country, jewellery 53 per cent., coal 51 per cent., hotels and restaurants 46 per cent., fish and poultry, public-houses 45 per cent.,† drapery

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* *Vide* Appendix B (1) and (3) for details and statistical explanation of lower percentages of wages and salaries to sales in smaller businesses.

† It must be understood that this does not represent the percentage of drink sold in the Saorstát as it is also sold in public-houses and grocery, general, and other shops throughout the country.

37 per cent., and chemists 33 per cent. The total retail sales in Dublin represent 33·5 per cent. of the total for the entire country.

Distribution of Expenditure of the Retail £

Although there is no break-up into commodities or commodity groups in the Census, which would give an approximate idea of the relative values of the consumption of important commodities in different districts, it is, however, possible to ascertain the distribution of expenditure of the retail £ in various types of shops.

The retail £ was expended throughout the Saorstát thus: grocery and provisions 4*s.* 10*d.*, drapery 3*s.* 3*d.*, public-houses and grocery, other and general shops, 2*s.* 8*d.* each; public-houses 1*s.* 4*d.*, hotels and restaurants, fresh meat, cycles and automobiles 9*d.* each; sweets, tobacco and newspapers 8*d.*; coal, chemists 5*d.* each; milk and dairy products, metal goods 3*d.* each; bread and flour, confectionery, fish and poultry, grain and forage, jewellery, paper, stationery and books, vegetables and fruit 2*d.* each.

About 11*s.* in the £ was spent in shops mainly engaged in selling foodstuffs and drink.

The retail £ was distributed in Dublin City as follows: drapery 4*s.* 3*d.*; grocery and provisions 3*s.* 5*d.*; other and general shops 2*s.* 10*d.*; public-houses 1*s.* 10*d.*; fresh meat, hotels and restaurants, sweets, tobacco and newspapers 1*s.* each; cycles and automobiles 10*d.*; public-houses and grocery 9*d.*; coal 8*d.*; milk and dairy products 6*d.*; chemists 5*d.*; paper, stationery and books, fish and poultry 4*d.* each; jewellery, metal goods, vegetables and fruit 3*d.* each; bread and flour confectionery 2*d.*

In Dublin the sales in shops selling food and drink amounted to 9*s.* 3*d.* in the £.

The combined retail expenditure of the £ in the four county boroughs of Cork, Limerick, Dun Laoghaire and Waterford was: grocery and provisions 4*s.* 2*d.*; drapery 3*s.* 9*d.*; other and general shops 2*s.* 8*d.*; public-houses 1*s.* 7*d.*; public-houses and grocery 1*s.* 3*d.*; fresh meat 1*s.*; cycles and automobiles, sweets, tobacco and newspapers 11*d.* each; hotels and restaurants 9*d.*; coal 7*d.*; chemists 6*d.*; bread and flour confectionery, metal goods 5*d.* each; milk and dairy products 4*d.*; fish and poultry 3*d.*; jewellery, paper, stationery and books, vegetables and fruit 2*d.* each.

About 10*s.* in the retail £ was spent in shops in these combined county boroughs selling foodstuffs and drink.

The distribution of a £ in shops in the eight towns with a population between 10,000 and 20,000 was: drapery 4*s.* 1*d.*; grocery and provisions 3*s.* 9*d.*; public-houses and grocery 3*s.* 2*d.*; other and general shops 3*s.* 11*d.*; cycles and automobiles, fresh meat 11*d.*

each; metal goods, public-houses, sweets, tobacco and newspapers 9*d*. each; hotels and restaurants 7*d*.; chemists 5*d*.

The combined expenditure in shops in these towns selling food and drink amounted to 9*s*. 2*d*. in the £.

For the rest of the country the distribution of the retail £ was: grocery and provisions 6*s*. 3*d*.; public-houses and grocery 4*s*. 5*d*.; other and general shops 3*s*. 5*d*.; drapery 2*s*. 4*d*.; public-houses 1*s*.; cycles and automobiles 7*d*.; fresh meat, hotels and restaurants 6*d*. each; sweets, tobacco and newspapers 5*d*.; chemists 4*d*.; metal goods 3*d*.

The proportion of the £ spent in shops retailing food and drink in districts with a population less than 10,000 was 12*s*. 8*d*.

APPENDIX A

The Human Element in Retail Distribution in the Saorstát

No Engaged	Males	Females	Working Proprietors		Members of Proprietors' Families		Others Engaged	
			Male, %	Female, %	Male, %	Female, %	Male, %	Female, %
124,799	54·5	45·5	18·2	11·3	6·7	15·6	29·6	18·6
			29·5%		22·3%		48·2%	

Total Numbers Engaged and Percentage of Males and Females in Retail Trade in Towns with a Population of over 10,000 *and in the Rest of the Country*

	Total Engaged (000's)	Male, %	Female, %		Total Engaged (000's)	Male, %	Female, %
Dublin ...	29·4	55·8	44·2	Drogheda ...	1·0	63·6	36·4
Cork ...	7·4	46·9	53·1	Sligo ...	0·9	55·1	44·9
Limerick ...	3·3	53·9	46·1	Wexford ...	1·0	60·1	39·9
Dun Laoghaire ...	2·1	59·9	40·1	Tralee ...	1·0	54·4	45·6
Waterford ...	2·4	56·5	43·5	Kilkenny ...	1·1	55·0	45·0
Galway ...	1·0	55·2	44·8	Bray ...	0·7	53·2	46·8
Dundalk ...	1·2	57·2	44·3	Rest of country...	72·3	54·5	45·5

Businesses in which Males Preponderated

	% of Total Engaged
Coal	92·3
Cycles and automobiles ...	88·4
Metal goods	80·2
Fresh meat	76·9
Chemists	75·9
Jewellery	75·5
Grain and forage... ...	71·2
Fish and poultry... ...	66·9

Businesses in which Females Preponderated

	% of Total Engaged
Hotels and restaurants...	68·6
Sweets, tobacco and newspapers	64·6

Businesses Worked largely by Family Labour

	% of Total Engaged
Sweets, tobacco and newspapers	69·5
Grocery and provisions ...	68·1
Public-houses	68·0
Vegetables and fruit ...	67·8
Public-houses and grocery	61·0

Businesses Worked largely by Non-family Labour

	% of Total Engaged
Coal	81·5
Hotels and restaurants...	79·9
Metal goods	72·0
Drapery	68·2
Cycles and automobiles	66·6
Grain and forage ...	65·4
Chemists...	64·3
Fish and poultry ...	62·5
Jewellery	60·1

APPENDIX B

(1) *Analysis of Family Labour and Wages in the Retail Trade*

Size of Business	Family as Percentage of Total Engaged, %	No. of Family Engaged per Shop	Persons Engaged per Shop	Average Wage per Person Paid	Average No. Paid Wages per Shop
£100 and less than £500	86·8	1·7	2·0	£40	0·4
500 ,, ,, 1,000	71·9	1·9	2·6	49	1·0
1,000 ,, ,, 2,500	54·0	1·9	3·5	64	2·1
2,500 ,, ,, 5,000	34·8	1·8	5·1	79	4·0
5,000 ,, ,, 10,000	21·9	1·6	7·5	93	6·6
10,000 ,, ,, 50,000	6·5	1·2	18·0	113	17·1
50,000 or over	0·2	0·2	100·2	130	100·1

(2) *Percentage Distribution of Shops and Retail Sales*

Size of Business	No. of Shops, %	Total Sales, %	Sales per Person Engage
Less than £100	13·6	0·4	£37
£100 and less than £500 ...	35·0 48·6	5·5 5·9	134
500 ,, ,, 1,000 ...	17·8 66·4	7·6 13·5	266
1,000 ,, ,, 2,500 ...	18·2	17·3	445
2,500 ,, ,, 5,000 ...	8·6	18·0	678
5,000 ,, ,, 10,000 ...	4·4	18·1	914
10,000 ,, ,, 50,000 ...	2·3	24·9	983
50,000 or more	0·1	8·2	1,015

(3) *Total Amount Paid in Wages and Salaries as a Percentage of Sales*

Size of Business	Saorstát, %	Dublin, %	Towns Pop. 25,000 50,000, %	Towns Pop. 10,000 20,000, %	Rest of Country
£100 and less than £500	5·7	7·0	7·9	7·8	5·0
500 ,, ,, 1,000	7·1	10·0	9·0	10·3	6·0
1,000 ,, ,, 2,500	8·5	11·1	10·4	9·0	7·1
2,500 ,, ,, 5,000	9·1	11·0	12·0	9 5	7·1
5,000 ,, ,, 10,000	9·0	11·0	13·1	9·4	6·8
10,000 ,, ,, 50,000	11·1	13·6	13·3	9 6	7·0
50,000 or more	12·8	12·8	13·3	9·6	7·0

APPENDIX C

No. of Times Stock was Turned Over in the Year by Six Types of Business in the Saorstát and in Dublin City

Size of Business	Grocery and Provisions	Public-house	Drapery	Jewellery	Chemists	Cycles and Automobiles
£100 and less than £500	5·8	5·8	1·1	0·8	1·4	3·5
500 ,, ,, 1,000	7·3	7·7	1·3	0·9	2·0	4·4
1,000 ,, ,, 2,500	7·9	7·4	1·4	1·0	2·3	4·8
2,500 ,, ,, 5,000	8·1	6·5	1·6	0·8	2·9	5·4
5,000 ,, ,, 10,000	8·2	6·1	2·0	1·2	2·8	6·8
10,000 ,, ,, 50,000	8·2	2·3	2·3	1·0	2·5	5·6
50,000 and over	3·9	—	3·1	—	—	—
All businesses	7·4	6·4	2·0	1·0	2·5	5·8
		Dublin				
£100 and less than £500	7 3	3·6	2·3	*	1·2	6·2
500 ,, ,, 1,000	12·3	8·1	2·0		2·4	6·1
1,000 ,, ,, 2,500	14·4	7·8	2·0		2·9	6·2
2,500 ,, ,, 5,000	15·5	6·5	2·2		3·2	6·7
5,000 ,, ,, 10,000	15·6	6·5	3·0		3·1	7·6
10,000 ,, ,, 50,000	8·4	2·2	3·0		3·1	6·2
50,000 and over	8·4	—	3·9		—	6·2
All businesses	11·2	4·8	3·3		3·0	6·5

* No figures are given for stocks and sales for varying classes of jewellery business in Dublin.

Notes.—As the figures in the Census for stocks on hand are given at cost and for sales at selling prices, a percentage deduction from the latter is made so as to ascertain the annual rate of stock turnover. The percentage deduction in each case was found by consulting principals of representative firms in the various trades.

A gross margin of 12½ per cent. is allowed on sales in grocery and provisions, except in businesses with a turnover of over £10,000 per annum, where 16 per cent. is taken, and 15 per cent. in "all businesses," in public-houses about 33⅓ per cent., in drapery 25 per cent., except where the turnover exceeds £10,000 per annum, in which 33⅓ per cent. is allowed, in jewellery 33⅓ per cent., chemists about 33⅓ per cent., and cycles and automobiles 25 per cent.

APPENDIX D

IMPORTANCE OF DUBLIN CITY IN RETAIL TRADE

Population

Total	Male, %	Female, %	% of Population of the Saorstát	% Increase, 1926–1936
467,691	47·0	53·0	15·8	15·7

No. of Persons Engaged in Retail Shops

Total	% of Total in the Saorstát	Male, %	Female, %	Proprietors, %	Members of Family, %	Others Employed, %
29,445	23·6	55·8	48·2	17·8	10·3	71·9

Wage-earners and Wages Paid in Retail Shops

Total No. of Wage-earners	% of Total in the Saorstát	Total Wages	% of Total Wages Paid in Saorstát	Average Wage per Person Paid
23,467	33·3	£2,468,121	42·1	£105·2

No. and Sales of Shops in Dublin City as a Percentage of Corresponding Totals in the Saorstát

Kind of Business	No. of Shops, %	Sales, %.
Grocery and provisions	8·5	23·1
Public-houses	9·0	44·6
Drapery	15·8	37·3
Sweets, tobacco, etc.	23·9	23·3
Fresh meat	19·3	56·8
Fish and poultry	35·5	44·7
Coal	22·9	51·4
Metal goods	20·4	25·6
Jewellery	25·7	53·2
Chemists	25·7	33·4
Hotels and restaurants	24·2	46·3
All businesses	15·0	33·5

APPENDIX E

Distribution of Expenditure of the Retail £ in Various Classes of Shops

Kind of Business	Saorstát		Dublin		4 County Boroughs Pop 28,000-80,000		Towns Pop. 10,000-20,000		Rest of Country	
	s.	*d.*	*s.*	*d.*	*s.*	*d*	*s.*	*d.*	*s*	*d.*
Grocery and provisions ...	4	10	3	5	4	2	3	9	6	3
Drapery	3	3	4	3	3	9	4	1	2	4
Public-houses and grocery ...	2	8		9	1	3	3	2	4	5
Public-houses	1	4	1	10	1	7		9	1	0
Cycles and automobiles ...		9		10		11		11		7
Fresh meat		9	1	0	1	0	1	0		6
Hotels and restaurants ...		9	1	0		9		7		6
Sweets, tobacco, etc.		8	1	0		11		11		5
Chemists		5		5		6		5		4
Coal		5		8		7		—		—
Metal goods		3		3		5		9		3
Other shops	3	11	4	7	4	2	3	8	3	5

WAGE RATES IN THE UNITED KINGDOM, 1934–1937

By E. C. RAMSBOTTOM

IN a paper on "The Course of Wage Rates in the United Kingdom, 1921–1934" (*Journal R.S.S., Part IV*, 1935) index numbers were given (in Appendix A) showing the percentage fluctuations in weekly rates of wages in a number of industries from 1920 to 1934, the average level of 1924 being taken as = 100. In view of enquiries which have been received as to whether figures are available for later dates, the following Table has been prepared giving corresponding index numbers for the end of each of the years 1935–1937. The index numbers for the end of 1934, which were given in the paper, are repeated for convenience of reference.

Industry	Index Numbers for end of December (average for whole year 1921 = 100)			
	1934	1935	1936	1937
Agriculture :—				
England and Wales	110	114	115	120
Scotland	87	89	92	99
Mining and Quarrying :—				
Coal Mining	84	84	91	97
Iron Mining	94	96	102	121
Other Mining and Quarrying *	93	94	96	98
Chemical, etc., Industries :—				
Heavy Chemicals	101	101	99	104
Drugs and Fine Chemicals	96	96	100	102
Soap and Candles	100	100	100	100
Seed-crushing and Oil-cake	96	100	100	109
Paint, Colour, Varnish, etc.	102	102	107	107
Engineering, Shipbuilding and Metals :—				
Iron and Steel	91	94	98	112
Engineering †	101	104	107	113
Tinplate	88	91	94	101
Tube Manufacture	101	105	109	118
Ship-building and Repairing ‡	108	108	112	121
Light Castings	101	101	104	110
Electric Cable, etc., Manufacture ...	88	96	99	103
Brass Wares	96	99	102	106
Gold, Silver, Electro-plate, etc.	100	100	100	119
Other Metal Industries §	96	96	96	104

* Including shale mining and stone quarrying.
† Including railway engineering shops.
‡ Time-workers.
§ Including heating and domestic engineering; tin box manufacture; stamped and pressed metal wares; spade, fork, etc., manufacture; screw manufacture.

In Table VI of the paper (*Journal*, 1935, page 655), general averages were given, for all the above industries combined, calculated

Industry	Index Numbers for end of December (average for whole year 1924 = 100)			
	1934	1935	1936	1937
Textile Industries :—				
Cotton	86	84	87	92
Woollen and Worsted	82	82	89	89
Hosiery	85	86	90	90
Carpets	93	93	93	93
Jute	95	95	95	99
Flax, etc.	88	92	93	95
Lace	100	100	100	103
Silk	92	92	92	94
Textile Bleaching, Dyeing, etc.	82	84	86	91
Clothing, etc., Industries :—				
Tailoring	104	104	104	111
Dressmaking and Women's Light Clothing	99	99	99	107
Hat, Cap and Millinery Trades	98	98	98	105
Boot and Shoe Manufacture	93	91	92	96
Laundries	100	100	100	112
Dyeing and Dry Cleaning	95	95	95	95
Food, Drink and Tobacco Industries :—				
Flour-milling	102	103	105	105
Baking	97	99	99	100
Sugar Confectionery and Food-preserving	100	100	100	107
Brewing	99	100	101	102
Aerated Waters	103	103	103	103
Tobacco	100	100	100	100
Paper, Printing, etc., Industries :—				
Paper Manufacture	94	95	96	98
Paper Box Making	97	97	97	97
Paper Bag Making	96	96	96	96
Printing and Bookbinding	101	100	100	100
Building, Contracting, and Allied Industries :—				
Building	92	94	97	100
Public Works Contracting	92	92	96	97
Electrical Installation	95	98	99	101
Cement Manufacture	105	112	112	119
Brick Manufacture	103	104	107	107
Electricity, Gas and Local Authority Non-Trading Services :—				
Electricity Supply	101	104	105	109
Gas Supply	102	102	106	109
Local Authority Non-Trading Services	99	100	101	104
Transport :—				
Railway Service	95	95	96	99
Tramways	102	104	108	111
Road Transport (Goods)	96	98	99	100
Docks	96	97	100	108
Shipping	86	88	93	95
Miscellaneous :—				
Coke Ovens	86	87	93	105
Pottery	93	97	100	102
Leather Tanning	95	95	98	105
Leather Goods	92	92	92	100
Furniture	92	94	97	101
Coopering	94	94	98	103
Vehicle Building	97	97	101	107

by the use of weights roughly proportional to the estimated aggregate weekly full-time earnings in each industry (*a*) in 1924 and (*b*) at June 1934. Corresponding figures for the end of each of the years 1934 to 1937 are given below :—

Base	Index Numbers for End of December			
	1934	1935	1936	1937
Average of 1924 = 100	94·4	95·6	98·6	103·1
June 1934 = 100	100·4	101·9	104·7	108·9

All the foregoing figures should be read in the light of the explanations and qualifications given in the original paper (and appendices) referred to above.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

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1.—*The Methods of Statistics: an Introduction Mainly for Experimentalists.* 2nd Edition, revised and enlarged. By L. H. C. Tippett. London: Williams and Norgate, 1937. 9″ × 6″. 280 pp. 15*s*. net.

The past year has seen the re-issue of practically all the fundamental English statistical textbooks. The statistician who can afford them has been able to add to his shelves the 11th edition of Yule (and Kendall), *Introduction to the Theory of Statistics*, the 6th editions of Fisher, *Statistical Methods for Research Workers*, and Bowley, *Elements of Statistics*, and the 2nd edition of Fisher, *Design of Experiments*. Now comes a new edition of Tippett. The author, statistician to the British Cotton Industry Research Association, published the first edition in 1931 (see review in *Journal*, 1932, Vol. XCV, II, p. 323), and, as he indicates, he writes in the main to expound the analysis of variance. He omits all reference, as he says, to the theory of ranks. This is unfortunate, for there is room for a book containing a satisfactory treatment of this. For many psychological and pedagogical problems the research worker is forced to use ranks, and for the great majority of these problems there is need for an accessible exposition of a sound technique that will deal adequately with these in relation to the size of population ($n = 20$ to 50) with which he has to deal. The author in this book writes throughout as a practising statistician and as an experienced teacher, and the book can be highly recommended: it is sound and workmanlike, attractively and carefully printed and well got up, and the reader who digests it will have a good mastery of some of the modern statistical technique.

A few very minor critical comments may be made. Typographical errors are to be found on p. 29 ("median" in l. 1 should be in italics), pp. 41 and 65 (alignment faulty), a comma is omitted on p. 117, 'as' appears as 'a' on p. 173, and the formula of p. 215, l. 10, is $d = x - \bar{x}_s - \bar{x}_t + \bar{x}$. We do not like the author's use of Sx, etc., instead of the more usual $S(x)$, to indicate the sum of all x terms, nor his use of the phrase "correct to 3 units" (p. 19). The learner may be a little puzzled by not having the convention about direction of skewness explained (p. 21: though p. 34 defines positive skewness), by the 1116 cases of p. 31 in place of the 1117 of p. 22, by the definition of probability in terms of "equally likely chances" (p. 44), by the failure to refer on p. 57 to p. 40, on p. 255 to p. 175, and by the reference on p. 112 to 52 treatments. The table of p. 60 should perhaps include values for $w = 1{\cdot}65$ to make clearer the exposition about the 5 per cent. and 2½ per cent. tails (p. 77). It would be an advantage also to define Latin Square (p. 230) to explain how it differs from a systematic arrangement such as that of p. 229. The readers of the *J.R.S.S. Supplement* will remember what in the spectacle-glass data is meant by "seed": perhaps a definition on p. 218 would have been helpful. And the enquiring mind wonders what plant it is that has the many varieties of flower colour of p. 102.

The explanations usually given by the author are full and careful. He gives, where possible, arithmetical, graphical, algebraic, and verbal expositions of the same point, and one at least of these ought to appeal and be meaningful to any experimentalist who uses the book. We like also the repeated use of the same example to illustrate various points. The most used of all these appears in one form or another on pp. 19, 27, 62, 111, 132, and as Tables 1.3, 2.6, 6.4, but this is an artificial population. It is not explained on what basis the population was constructed nor why an artificial population was used. It would not have been difficult to find a population of 100 with an average measure of 50: any school or Civil Service Commission examination list would provide a more natural population that would serve to illustrate the arguments. It may be noted that Table 6.4 (p. 132) appears to be in error: the sum of squares between groups seems to be 1808·35 and the total 8864·75, putting the z test arithmetic wrong, though the z is still insignificant. We have not detected any other numerical slip, so that, as above stated, the reader who works through the book carefully will be able to follow some of the more complicated work to be found in other writers.

F. S.

2.—*Random Variables and Probability Distributions.* By H. CRAMÉR. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 36.) Camb. Univ. Press, 1937. 8½″ × 5½″. viii + 122 pp. 6*s.* 6*d.*

In the preface to this work the author begins: "The Mathematical Theory of Probability has lately become of growing importance owing to the great variety of its applications, and also to its purely mathematical interest. The subject of this tract is the development of the purely mathematical side of the theory, without any reference to the applications."

The theory of probability has been treated throughout by the methods of modern analysis, and those who are not completely familiar with the rigorous detail of this particular branch of mathematics will, like the reviewer, find some of the theorems and their proofs rather difficult reading. But it is to be hoped that these readers will not be deterred by this; for while Cramér's tract does not break any fundamentally new ground, it epitomizes in a very useful way the present status of the mathematical type of probability theory with which Cramér is concerned.

In the First Part the author follows Kolmogoroff in the axiomatic basis for the theory that he sets up. Avoiding the attempt by von Mises to define probability in terms of an unlimited sequence of values, he merely associates a number with an event, and considers reasonable rules for operating with such numbers. The relation these probability numbers must have with frequency suggests that they must be additive, in the sense that if two exclusive events A and B can occur, the probability of A or B occurring should be equal to the sum of the separate probabilities of A and B. In this way probabilities are associated with additive set functions, and their usual properties follow from the known properties of such functions in the theory of measure.

To some readers this beginning may seem too sophisticated, but from the point of view of mathematical analysis it is a fairly natural and logical one. In fact, if we wish to generalize the notion of probability used in elementary algebra, where, of a finite class of objects, the fraction of a given type is also interpreted as a probability number, the generalization from rational fractions to the whole modern theory of measure implies that probabilities may automatically be defined in this latter theory with complete consistency. (In natural philosophy mere consistency is not, of course, sufficient, but remember we are discussing pure mathematics.)

In the Second (and main) Part the distributional properties of a random variable are developed, with special reference to the distributions of sums of independent variables and their approach to normality. The terminology used by Cramér for a distribution law requires noting. The probability $P(S)$ of the set S of points $X\epsilon x$ is the *probability function*; the function of x, $F(x) = P(S)$ is formally distinguished and is the *distribution function*; and if $F(x)$ is absolutely continuous, its derivative $F'(x)$ is the *frequency function*. This kind of classification is essential for the unification of formulæ valid for both continuous and discrete types of distribution; but to avoid confusion with other common terminology it might help to think of $F(x)$ as the *cumulative frequency function*, as there seems no reason for reserving the word *frequency* for the particular kind of function, $F'(x)$.

The characteristic function $f(t)$, from which the inversion formula for $F(x+h) - F(x)$ may be derived, is defined in terms of the Fourier–Stieltjes transform of $F(x)$, being the Lebesgue–Stieltjes integral

$$f(t) = E(e^{itx}) = \int e^{itx}\, dF(x).$$

From the fundamental relation for the characteristic function $g_2(t)$, say, of $Y_2 = X_1 + X_2$, where X_1 and X_2 are independent,

$$g_2(t) = f_1(t) f_2(t),$$

the limiting properties of a sequence whose nth term is the sum of n independent components is investigated. This sequence Y_n would be said to *converge in probability* to Y if the probability of $|Y_n - Y| > \varepsilon$ (for any $\varepsilon > 0$) tends to zero as n tends to infinity; but further discussion of such convergence is avoided by the substitution of the convergence of the distribution law for Y_n, or correspondingly the convergence of $g_n(t)$ to $g(t)$. The general theorem on convergence to the normal distribution is called the *Central Limit Theorem*, and a necessary and sufficient condition for this convergence (a condition first given by Lindeberg) is established. Other items in this Part include a derivation of the asymptotic expansion for the distribution of Y_n, when n is large, and a discussion of the *homogeneous random process*, which is a generalization from a sum of finite components to a time integral of infinitesimal components. In the Third Part the extension of previous theorems to vector variables of more than one dimension is briefly touched on.

It would be fairly easy to find fault with Cramér for his omissions. The Central Limit Theorem occupies the central position in the book; other topics, *e.g.* convergence in probability, the sampling problem, etc., not being discussed at any length. Statisticians may rather regret that theorems related to the convergence of "likelihood" estimates could not have been included, as they might conveniently be associated with the Central Limit Theorem. It seems also a pity that Cramér, while rigorously building his theorems on analysis, did not pause occasionally to stress the underlying algebra which determines the form of some of these theorems. For example, the properties of the function $f = E(e^{itx})$, and of its logarithm, are necessarily important, whether or not Fourier theory is introduced. No special name is allotted to $\log f$ in the book, in spite of its close relation with the theory of linear sums of components, and its tendency for such (appropriately scaled) sums to approach $-\frac{1}{2}t^2$, the property on which the proof of the normal limit depends.

When we consider how far such possible criticisms are relevant, we must, however, be careful to remember the exact scope that the author has deliberately set himself. To those interested in the mathematical theory of probability, this tract is recommended as an admirable survey of this theory's recent development as a branch of the theory of functions.

M. S. B.

3.—*L'Emploi des observations statistiques : méthodes d'estimation.* Par Georges Darmois. [Actualités scientifiques et industrielles, 356. Statistique mathématique : exposés publiés sous la direction de G. Darmois. I.] Paris: Hermann, 1936. 9⅝″ × 6⅞″. 29 pp. 10 *frs.*

Since this publication is chiefly a frank exposition of some of R. A. Fisher's contributions to the theory of statistical estimation, comparatively little comment here is needed. After some introductory remarks on the idea of estimation, the author goes on to classify different kinds of estimates in large sample theory. Of estimates which have definite limits as the size of sample increases indefinitely, those whose limits are in fact the required parameters are called *correctes* (Fisher's consistent statistics). Of the class of consistent estimates whose limiting distributions are normal, the special mathematical properties possessed by maximum likelihood estimates are stated, and the extent to which these properties have been established with complete rigour is briefly discussed. The more general theory of small samples leads to the further ideas of intrinsic accuracy and amount of information. The important class of estimates known as sufficient are called *exhaustives*.

This is a very useful recapitulation of Fisher's theory of estimation (excluding the idea of fiducial probability introduced later by Fisher). To the reviewer it is a welcome indication of a growing awareness on the Continent of modern advances that have been made in the theory of statistical inference. M. S. B.

4.—*Interpolation and Allied Tables.* Reprinted from the *Nautical Almanac* for 1937. London: H.M. Stationery Office, 1936. 9¾″ + 6″. 44 pp. 1*s.* net.

The Tables and accompanying Explanation in this booklet have been printed from stereotype plates of the *Nautical Almanac* for 1937. His Majesty's Stationery Office are to be congratulated on reproducing in a cheap and accessible form material which will be of service to all students of interpolation and allied computational processes.

Of the numerous formulæ for the interpolation of a function tabulated at equal intervals of the argument the booklet considers two, the Bessel and the Everett central-difference formulæ, as being the most convenient for practical work. Tables are given of Besselian and Everett interpolation coefficients up to B^{vi} and E^{vi} (*i.e.* for the use of central differences up to and including the sixth order). The explanatory section also considers interpolation from values of the function without the use of differences, and gives tables of the constants required for direct interpolation which takes account of differences up to the third. A notable feature is the inclusion of certain tables of the "critical" type, *i.e.* giving the limiting values of the independent variable (the fraction of the interval) for which the B and E coefficients have fixed values.

A short account is also given of Dr. Comrie's method of the "throw-back" whereby small high-order differences can be taken into account by using modified differences of lower order. Tables are given for the use of this method in the throw-back from fourth- to second-order differences.

The Explanation gives a new method of inverse interpolation based on the Bessel formula. Other tables assemble formulæ for expressing derivatives in terms of differences, provide the coefficients necessary to compute first and second derivatives, give expressions for differences in subdivided intervals in terms of the original differences, and give formulæ for approximate numerical integration.

The Nautical Almanac Office have succeeded in adapting many commercial calculating and accounting machines to their computational requirements, and the Explanation gives some examples of the use of mechanical methods in applying the formulæ and tables of the booklet. The amateur can only look with envy on the description of a method of inverse interpolation involving the use of two machines, and even hardened computers will experience mixed emotions at the suggestion that one of the tables can be interpolated "with the aid of Crelle or even a third machine"! A natural awe at this Briggsian breadth of arithmetical outlook should not, however, deter the ordinary worker from obtaining the booklet, which will form a valuable manual to those already possessing an elementary theoretical knowledge of interpolation. A word should be added in praise of the type, which is uniformly clear and has evidently been read with the greatest care. M. G. K.

5.—*Sur la Théorie Mathématique des Jeux de Hasard et de Réflexion.* Par René de Possel. Paris: Hermann, 1936. 10″ × 6⅝″. 48 pp. 10 *frs.*

This brochure gives an introductory sketch to a general theory of social games, *i.e.* games in which more than one person takes part. A game is considered as composed of three factors: *reflection*, in which the player tries to envisage all the possible situations which can arise according to the different decisions made by his opponent, *chance*, which results from unknown or unanalysable systems of causation, and *guile* (la ruse), in which the player attempts to penetrate his adversary's thoughts while concealing his own. Some games, such as bridge, contain all three factors. Others may contain only one. As an example of a game which consists almost entirely of guile, M. de Possel cites the rather doubtful case of "Scissors-cut-paper," which passes in France under the delightful name of "Baccarat du Bagne" because no apparatus is necessary to play it—not even clothes.

M. de Possel attacks the rather unpromising problem of analysing these factors by following lines due to J. von Neumann. Reflection is considered as the construction of a list of all possible contingencies and of the various courses of action by which they are to be followed—the list for the most part, of course, being carried in the player's head. Chance is dealt with on orthodox lines. The influence of guile is studied by considering the maximum gain accruing to a player who penetrates his opponent's thoughts completely.

The author's principal object is to exhibit the social game as composed of these three factors, and he does not proceed to develop the analysis further or to show how it can be applied to improving one's play in actual games. His approach may, however, be of interest to statisticians who find that their sampling results cannot be satisfactorily explained on the basis of the operation of laws of chance alone. M. G. K.

6.—*The Mathematical Problem of the Price Index.* By J. K. Montgomery, M.A., M.Sc. London: P. S. King. 7¼″ × 4¾″. 74 pp. Price 6*s.* net.

The author has devised a mathematical formula of a novel kind for the price index. After some discussion of the problem, Mr. Montgomery gives the following definitions of the price index and the quantity index: "The price index is the change, *measured as a ratio,* in the aggregate value produced by the changes in price (when occurring simultaneously with the changes in quantity) and the quantity index is the change, *measured as a ratio,* in the aggregate value produced by the changes in quantity (when occurring simultaneously with the changes in price)." The formula for the price index, in the usual notation is given by:

$$\log P_{01} = \frac{S(p_1q_1 - p_0q_0)\,\dfrac{\log(p_1/p_0)}{\log p_1q_1/p_0q_0}}{S(p_1q_1 - p_0q_0)} \log \frac{S(p_1q_1)}{S(p_0q_0)};$$

that for the quantity index is given by:

$$\log Q_{01} = \frac{S(p_1q_1 - p_0q_0)\,\dfrac{\log(q_1q_0)}{\log(p_1q_1/p_0q_0)}}{S(p_1q_1 - p_0q_0)} \log \frac{S(p_1q_1)}{S(p_0q_0)}.$$

In a discussion of these indices the author finds that Fisher's Ideal Index is the geometric mean of the limits between which Mr. Montgomery's index must lie. The new Indices comply with Fisher's time reversal test.

In a practical illustration the author finds that his index works out at 161·74 compared with Fisher's ideal index of 161·56.

The book is severely mathematical in character, and it is difficult to trace the argument, but it should be read by all those interested in the making of index numbers. E. C. R.

7.—*A Study of the Capital Market in Post-War Britain.* By A. T. K. Grant. London: Macmillan, 1937. 8¾″ × 6″. xx + 320 pp. 12*s.*

This excellent book is a complete justification of the award to the author of a Leverhulme Research Fellowship in 1935, which enabled him to conduct the enquiries necessary to this piece of investigation. Like all good books, it will arouse some controversy; like all books of wide scope, it will evoke complaints that this or the other section has not been sufficiently handled. As Mr. Grant says in his preface, he has had to explain the workings of a complicated system, show how it has been modified by the impact of recent economic events, and relate the visible results, positively or negatively, to the teachings of the exponents of economic theories. The task has been made none the easier by the fact that the details of economic financing are not usually exposed to the light of day, and that statistics of the capital market are by no means superabundant. Mr. Grant has read widely and questioned assiduously, and in the end he has made a conspicuous contribution to our knowledge of contemporary finance.

The first part of the book describes the scope of the subject, the structure of indebtedness, the influence of interest, the impact of change, and banking policy. His treatment of interest is particularly suggestive; in summary it is that long-term rates are determined by long-period expectations, and so smooth themselves out in time, but are affected by short-term rates when these influence expectations, and that the banking system can control short-term rates and " exert its influence on general economic conditions by making short-term investment opportunities more or less attractive relatively to long." The industrial borrower who has to borrow on short term must preserve a considerable liquidity in his assets and, consequently, must be cautious in making new commitments. The raising of the short-term rate will set in motion forces restricting new investment, but its lowering will further long-term investment. There are a variety of rates, and they do not all move together; in times of depression they fly apart, but with good times they converge. While the banking system can control short-term rates in a condition of equilibrium, its power is less complete as economic change proceeds; it may restrain a boom, it cannot control a slump. This is a very imperfect survey of fifty interesting pages.

Then follow 64 pages on the development of monetary policy since the war, and necessarily they give only an outline, for many of the facts are still obscure. In spite of criticisms on various points, Mr. Grant's conclusion is that " the capital market was hampered surprisingly little. . . . In so far as monetary policy is concerned, the industrialist in search of finance would seem to have no strong ground for complaint, whatever his legitimate grievances in other directions—as an exporter, for example. This does not, of course, mean that the capital market was necessarily working satisfactorily, but that blame for its shortcomings can hardly be laid at the door of restrictive policies pursued by the authorities." Next follows an account of the long-term capital market, occupying some 140 pages. Emphasis is laid on the fact that " the most usual form of new economic development is through the expansion of existing undertakings " by the utilisation of reserves. Really new enterprises are " dependent on the finance of individuals," people who " back their fancies " for a large prospective gain; these must start in a small way, and this form of expansion is probably not so great as that undertaken by existing business. All this is important for theory. The significance of investment intermediaries—banks, insurance companies, investment trusts, etc.—is strongly brought out in this section of the book, and the survey of their operations confirms the earlier opinion that established businesses can get, at a price, all the finance they need, but that new and potential business " is still in the main dependent on private individuals and groups who may be interested in proposals put before them." An interesting chapter succeeds on local financing in Manchester, Liverpool, Birmingham, and Bristol, and afterwards the special problems of building and agricultural finance are considered.

The fourth part (51 pages) treats of "present problems and future prospects." "The problem of financial control is largely one of so handling the monetary machine as to avoid generating booms and slumps, and to minimize the effects of disturbance when it occurs." It is affected by new circumstances---the absence of an international standard, the comparative insulation of money-markets, the persistent low level of long-term rates, the larger holding of Government securities by the banks, the "highly liquid condition" of business, and rearmament expenditure. The arguments cannot be reproduced here. "One thing is certain: that the problem of financial control cannot be solved by rigid adherence to any theoretical criterion. Inevitably, we are forced back on observation, guesswork, and rule-of-thumb methods in dealing with each problem of policy. There are always opposites to be reconciled and extra-economic considerations to be taken into account. There is no predetermined rule, however elaborate it be, which will automatically solve the difficulties which arise. But there is nothing alarming about this; this has always been the case, and will continue to be the case, in an economic world dominated by an uncertain future." Two other matters must be referred to before we close. While regarding the work of Mr. Keynes and Mr. Harrod as a "major contribution to our knowledge of business fluctuations," he considers it to be "in no sense a theory of the trade cycle." Secondly, "it is an accepted axiom that whenever the economic system as we know it to-day shows any signs of breaking down, the State is called in to lend its support. . . . This tendency is quite independent of political opinions or party programmes. . . . If our main objectives, as citizens and as private individuals, are to be security and stability, only the State can minister to our wants. . . . The problem of financing new enterprise will thus grow, and not diminish in importance in a world in which savings are invested with an eye to safety, while markets have ceased to expand." And so Mr. Grant leaves us with the greatest of all problems, the compatibility of progress and security and the importance of each relative to the other. Will he try his hand at determining the conditions of a solution? H. W. M.

8.—*British Corporation Finance 1775-1850: A Study of Preference Shares.* By George Heberton Evans, Jr. Baltimore: The Johns Hopkins Press, 1936. $8\frac{3}{4}'' \times 5\frac{3}{4}''$. 208 pp. $2.25.

When, as was not unusual a century or more ago, canal companies and, later, railway companies discovered, only too soon after flotation, that their funds would be exhausted long before their undertakings were completed, they were faced with certain alternative ways of procuring the additional funds necessary to avoid the almost total loss of capital already sunk in highly specialized fixed forms. If there were no hopes of Government aid, new funds might be obtained by bonds, mortgages, promissory notes, calls, annuities, or by the sale of further shares.

But the limitations, disadvantages and difficulties inherent in these methods were accentuated during the period under review, when large demands for capital were being made in all directions. How this, coupled with the generally accepted practice of paying interest out of capital, the strong demand for shares yielding a certain return, and the impossibility of paying dividends on all shares, made the coming of the preference share inevitable, is one of Professor Evans's main theses, which he convincingly supports with much original material.

He shows how this form of share, at first introduced as a bait for hesitant investors, found a wider place for itself, shedding in the process many of its original privileges, such as voting power, priority to debt, and unlimited participation in profits. His detailed story of the evolution of the preference share (which may be regarded as dating from about the beginning of the nineteenth century, although there were scarcely recognizable rudimentary forms considerably earlier), shows how it so rose in general esteem that by the middle of the century more than one hundred issues by railway companies alone had been authorized by Parliament. It was now no longer regarded as a mere emergency device, and was being employed for more normal purposes, yet it remained illegal for some years after this to issue preference shares without specific parliamentary authority.

In the interesting chapter on contemporary opinion an attempt has been made, on the basis of stock-market quotations, to obtain a definite measure of the public attitude, at the middle of the century, regarding the relative valuation of preference and ordinary shares. The results are shown in a striking diagram, but, ingenious though it be, one may be a little doubtful whether the figures prove all that is claimed for them, and even wonder what the conclusion reached really implies. There is much other interesting statistical material illustrating special aspects of the early canal and railway companies.

Students in particular will appreciate the adequate summary of the work embodied in the last chapter and the comprehensive index. And all interested in the subject will recognize the value of Professor Evans's researches, and welcome his comprehensive yet brief and extremely readable book. C. O. G.

9.—*World Prices and the Building Industry.* By G. F. Warren and F. A. Pearson. London: Chapman and Hall, 1937. 9″ × 6″. v + 240 pp. 17*s.* 6*d.* net.

The book divides itself into the two parts indicated by the title, though the second part is headed "Business Cycles." Of the connection between the two, the authors say in the preface: "The most important business factor to consider since 1914 has been the changing price level, that is, changes in the value of money. The next most important business factor is the building cycle." The book is full of diagrams—one to almost every paragraph—and the fact that most paragraphs can be summed up in a diagram indicates clearly the nature of the book. The diagrams are frequently on a microscopic scale, *e.g.* the movement of 18 food prices in relation to gold over the period 1913–36 is portrayed on a diagram half the width of a page; but had that particular diagram been on a large scale, the authors' statement that the fluctuations "are small as compared to the recent violent changes in the whole level of prices" would be more clearly recognized as somewhat lacking in accuracy. The first part is distinguished by an original index of world prices in gold compiled by weighting the index numbers of prices of 40 basic commodities in the United States (47), Canada (4), England (17), France (15), the Netherlands (3), Belgium (3) and Spain (11) by their respective populations. The population of the United States being nearly equal to that of the other six countries taken together gives the United States nearly a half share in the weighted average, but during the period subsequent to 1913 an unweighted average of the index numbers for the same countries differs but little from the weighted average except from 1917 to 1920. This world price index is compared with the index numbers for the seven countries mentioned and seven other countries, using the same 40 commodities in each case. These index numbers have been compiled both in terms of the currency of the country concerned and in terms of the gold value of that currency. The two are compared, and particulars given of the course of each currency subsequent to 1913. Most of the building statistics included relate to towns or areas in the United States. For this country, some particulars are given of new houses built in London and Glasgow and of the number of bricks produced in England and Wales 1785–1849. For towns in several countries particulars of empty houses as well as of new construction are available, and these show well-defined peaks occurring a few years after the peaks of construction. Reference is made to a number of other cycles—the well-known pig cycle is an example—and it is pointed out that the result of combining several cycles of unequal length is an apparently irregular movement. The authors suggest that study of the various cycles should make business forecasting more precise, and they conclude that at least three things are necessary in order to prevent building cycles and resulting unemployment and social disturbances from becoming more violent: "(1) A currency system that will prevent wide fluctuations in the purchasing power of the dollar; (2) better statistics, more research work, and public education concerning building cycles; and (3) definite plans for city, state, and federal government to extend building activity when private building is low and curtail such construction when private building is too active." This book appears designed to help in meeting the latter part of the second desideratum. H. L.

10.—*Retail Distribution, a Critical Analysis.* By Henry Smith. Oxford University Press. London: Humphrey Milford, 1937. 8¾″ × 5¾″. vi + 175 pp. 7*s.* 6*d.*

The claim that this book should be of value to all interested in the problems of retail and wholesale distribution is amply justified. The first chapter consists of an outline of the pure economics of retailing, to which subject the author has evidently given much careful consideration. From an examination of Kelly's Directories and by inference from the last Population Census, it is estimated that in England and Wales in 1931 there were 575,300 retail outlets, which are tabulated according to the type of goods handled. The average number of assistants employed, and the population served by each shop is also calculated. In discussing the value of the trade done by multiple and departmental stores, general shops and the retail Co-operative Societies, it is evident that far too little information is available, and that the best estimates must necessarily be based on assumptions. After several pages devoted to an analysis of the price policy of the Co-operative movement, the conclusion is reached that the movement "charges what the traffic will bear, except in those cases where the resulting profits are so large as to offend their sense of what is right and fair," and that the dividend is to some extent price determining rather than a pure resultant of the business done.

In dealing with the trend of change in retail trading over recent years, attention is given to the tendency of people "to live further out" and of the increasing facilities offered by transport services. No mention, however, appears to be made of the mail order business, which, although not large in the aggregate, may well be significant. The table showing the average annual rate of growth of various classes of shops for twelve areas in England and Wales is clearly the result of much hard work; the period to which the figures refer, however, should have been indicated in the heading. From the history of economic thought on retailing, it is clear that the concept of imperfect competition has been closely linked with critical analyses of the retail trade. "Under modern conditions, it is becoming increasingly clear that perfect competition is only competition under special circumstances, and in somewhat unusual circumstances." The author attaches much importance to the theory of imperfect competition, and discusses its influence on the growth of the costs of retailing. He concludes that the imperfection of the retail market is a dominant factor in the increase of retail costs.

In attempting to measure the changing costs of retail trading between 1924 and 1931, the author was bound to employ some statistical ingenuity, and he is ready to admit that the basis of his calculations cannot give a highly accurate result. It is estimated that the total cost of retailing rose from £362 mn. in 1924 to £586 mn. in 1931, an increase that reflected a steadily growing volume of retail turnover as well as an advance in retail margins. There was also a marked rise in the average labour costs of distribution.

In the final chapter, headed "The Trend of Current Controversy," three main types of reform are discussed: (*a*) regulation of the number of shops, (*b*) control of retail price maintenance, (*c*) extension of consumers' co-operation. The conclusion is reached that the last of the three alternatives offers the best solution to the problem of distribution.

The book bears the stamp of careful work, and can be commended to all interested in the economics of retailing. R. F. G.

11.—*Unemployment in the Learned Professions.* By Walter M. Kotschnig, Ph.D. Oxford University Press. London: Humphrey Milford. 1937. 9″ × 5½″. 347 pp. 12*s*. 6*d*.

In this book Dr. Kotschnig continues his consideration of the progress of higher education under the free play of historical circumstance. Broadly speaking, until it was published, hardly anyone had troubled to analyse the fundamental tenets and purposes of the increasing education of the people, to study its economic consequences. It has been taken for granted that as education proceeded, enlightenment and social harmony would follow, hence it has grown, as we allowed our industry to grow, haphazard and unplanned, with the result that nearly everywhere the present system of higher education is becoming unworkable.

It will be remembered that in his first book, *The University in a Changing World*, Dr. Kotschnig showed how nearly everywhere economic, social, and political considerations had ousted the two erstwhile chief functions of a university, the search for learning for its own sake, and the training of leaders for various branches of the national life. Here he goes on to deal with the changing product of the new university, selecting as his definition of the learned professions "those callings which require or tend to require of their members that they obtain their training at an institution of higher learning."

The book is divided into four parts. The first analyses the conditions of present and future supply of professional workers. It describes the changes in those who take a university training—most important, the vast increase in student enrolments so noticeable in all countries since the war, and the deterioration of universities which had been conceived for the few and not the many—and attempts to find the reasons. The second section is the most important in the book. For the first time, information is collected from almost every country of importance in the world, with the exception of Soviet Russia, to describe the plight of the professions. It shows the unemployment of professional persons by countries making clear where the roots of problems are similar, and traces as far as possible the results, political and economic, of their overcrowding. It displays the social degradation of the *sous-classé*, the discrediting of knowledge, and the revolutionary unrest which the unemployment of the educated middle class of the nations has brought about. This section incidentally throws a most instructive light on contemporary European politics.

The third section describes with great fairness the countermeasures to restrict supply which have been attempted: the effort to curtail new supply by control of student enrolments—in other words, by the rationing of higher education—the effort to take some of existing supply off the market by relief works and restrictive measures, such as forbidding women foreigners to practise; preventive measures to find new outlets for the unemployed by guidance and occupational planning.

The final section deals with the need for planning in education, with a study of the results of its lack, and discussion of the possibility of planning for ideal education.

Of these four sections the first is the weakest. The statistics relating to the supply of professional labour are, as Dr. Kotschnig points out, inadequate, and have sometimes been arranged to give misleading comparisons. Again, in analysing the causes of the influx of students, he deals with all except the expansion of secondary education in the twentieth century, which might be expected to be a *sine qua non*. But these are small drawbacks to a great book. For the first time, the facts of present higher education and its consequences have been brought together and compellingly presented. The dilemma of the educator has been made clear. One horn is the fundamental of democratic thought, equality of opportunity, which demands education for all, rich and poor, according to their powers. The desire for education as a panacea for their ills is rooted too deeply in the mind of the working classes to be eradicated. An extensive education remains their chief ambition for their children, and they will not allow the progress of education to be more than temporarily checked. Hence supply will expand with no limit. The other horn is a short demand coupled with the social feeling that the professional man, or the man trained for the professions, can only accept a certain kind of work. This work the present social system only requires in restricted quantity. Demand is limited and can only expand slowly. How can the two be reconciled? The Germans have temporarily and partially solved the problem by discrediting learning, honouring manual labour, and restricting access to higher education very severely. It is open to others to find better ways.

As regards our own country, we find that the British are practically the only nation in the world which does not suffer from a professional unemployment problem. In England almost alone, the university man expects to go into business, the chartered professions influence the supply of new entrants in its early stages, and the pressure on the universities is still quite bearable. But our good fortune may not last, and Dr. Kotschnig has shown what unplanned education leads to.

This book will probably have small appeal for statisticians as such; for a work that sets out to describe things as they are there is remarkably little measurement in it. Nevertheless one can unhesitatingly say that in its own subject it is a book of the very first importance, and no one would find that it did not repay reading.

R. W. S.

12.—*Economic Planning in Australia, 1929–1936*. By William Rupert MacLaurin, Assistant Professor of Economics and Social Science, Massachusetts Institute of Technology. London: P. S. King, 1937. $8\frac{3}{4}'' \times 5\frac{1}{2}''$. xv + 304 pp. 15*s*.

The descent of Australia into depression and the recovery therefrom have passed into history, but they contain valuable lessons both for the economist and the politician. It is well, therefore, that we have this record by an unbiassed investigator. The leading facts are clearly set out against their historical and economic background, and the contending personalities and conflicting forces are described without prejudice and without that acrimony which would have been natural in one who participated in the events themselves. For all this we are much indebted to Mr. MacLaurin. He has given us a clear account of what took place, reinforced it with sufficient, but not too many, statistics, and backed it up with a voluminous and detailed bibliography.

Economic planning is not to be taken in the sense in which we regard it in this country, as an integrated scheme for a co-ordination of production and distribution. It is rather a short, and not too accurate, expression for the efforts of several unco-ordinated institutions—the Commonwealth Bank, the Loan Council, the Arbitration Court, and the Tariff Board—to devise measures which would induce or compel the different sections of the community to recognize that the reduction of the national income required that they should accept a corresponding reduction in their respective shares. The work of the economists, Professors Giblin, Copland, and others, was also important, but they "were used only in a haphazard fashion . . . they were called in only on special tasks and with a particular problem to report on. And if they tried to broaden the base of their enquiries in order to make their work more effective, governments not infrequently were resentful." No uncommon experience!

The depression which descended on Australia was brought about by external causes, but the great extent to which her governments availed themselves of the generosity of "enthusiastic investors" in Britain and the extravagance with which they expended the proceeds on unsound projects made the Commonwealth vulnerable to the blasts of adversity. The efforts of Labour to maintain high wage rates, the Theodore policy of inflation, and the bank strike against Government borrowing added to the confusion, and the first relief came when the exchange was allowed to go against the Australian pound and reduce imports. The Arbitration Court contributed a cut in wages, the Loan Council a reduction of interest on internal loans, and the Tariff Board some moderation of duties, and government expenditure was reduced, while a programme of public works "undoubtedly stimulated recovery by increasing spending power." The policy of Australian Governments had always been to stimulate agricultural production and export; so in the depression the farmers were particularly hard hit by the fall in world prices, and Mr. MacLaurin's account of the efforts to help them by high domestic prices and by giving bounties on exports deserves all attention. "Government assistance sheltered inefficiency" is his verdict. "Debt relief measures made it possible for many farmers to continue in production when they ought to have been taken off the land."

Altogether this is a good book. H. W. M.

13.—*Industrial Assurance: An Historical and Critical Study.* By Sir Arnold Wilson, M.P., and Professor Hermann Levy. Oxford University Press, 1937. $9\frac{3}{4}'' \times 6\frac{1}{4}''$. xxxiii + 519 pp. *21s.*

The smaller the income, the greater the precautions we must take to prepare against the misfortunes of an unknown and uncertain future. The apostles of thrift point proudly to the enormous savings being made week by week by the great mass of wage-earners of this country. When the character of these savings is examined more closely, however, many of the more rosy features disappear.

Sir Arnold Wilson and Professor Levy have turned the cold spotlight of scrutiny on one particular type of working-class savings. Industrial assurance is assurance on the lives of working people, with the premiums collected at regular intervals (mainly weekly) by agents who call from house to house. The premiums are matters of a few pennies, and the payments which fall due on the death of the insured provide burial-money and perhaps a little over for dependents or relatives. The sums involved are tremendous: in 1930 the premiums collected amounted in the aggregate to £54,200,000. Of this sum no less than £18,400,000—34 per cent.—went in expenses and management. Equally disquieting is the number of lapsed policies. "Of nearly 10 million policies issued in the year 1929 . . . the number discontinued was somewhat over 6 millions, in the case of 1¼ millions of which, however, free policies or surrender values were granted, leaving the number of 'lapsed' policies as 4¾ million." These lapses are to be explained by the pressure for increase brought to bear upon the agents, and by the agents in their turn upon the public; the continuous growth in industrial insurance would not have been possible if the agents did not go all out to secure new business quite irrespective of the needs or earnings of those paying the premiums. The agent's income (whether he is paid on a commission basis or not) ultimately depends on his ability to secure new business and maintain the volume of the old. The lapses are worth while, not because they are profitable themselves, but because they are a necessary by-product of the securing of new business.

The indictment which Sir Arnold Wilson and Professor Levy put forward is a powerful one. Their case is that the working man gets poor value for his money; that even if expenses and commissions were lower and the assurance purchased of good value, the money might be better spent on the needs of the household; and that the whole system is biassed to favour the interests of insurance companies and their agents rather than the needs of the household itself. In the chapter on "Business-Getting" there are some quotations culled from the publications of the insurance industry whose spirit is most revealing. For example:

"We must always adapt ourselves to the circumstances as we find them, and it is never good tactics to assume that all husbands blindly carry out the wishes of the wives. The better plan is, having convinced the housewife, arrange that she tells her husband and that you are calling to see him to explain the policy to him. Say that you hope she will kindly be present. You may canvass the husband in the ordinary way and when it comes to ways and means tactfully suggest that as the lady always pays the premiums so well and regularly she will make it convenient to pay the new amount. . . . Do not show disappointment or impatience if he proves to have views of his own. Most men of any spirit naturally will have."

The fact is that the provision of insurance cover for those who can ill afford to spend the money is a major social problem, and if it is left to those who seek to make profit out of it, a host of attendant evils (particularized in detail in this study) will creep in.

What is to be done? The authors recognize that a number of improvements have been made in the course of time (they pay deserved tribute to the Prudential in taking the lead), but make it clear that piecemeal advances will not touch the fundamental problems. Under the present system it will always pay to persuade people to take more insurance than fundamentally they have need of, and as long as the profit motive continues, this will remain the case. Drastic action is therefore needed, but at once we are faced with the difficulty of tackling an extremely strong vested interest composed not only of the companies themselves, but also of the agents they employ. Pressure was brought to bear on Mr. Lloyd George not to include Death Benefit in his 1911 National Insurance Bill. The Cohen Report of 1933 attracted little attention in the press; it was an extremely valuable document, but it was too dangerous. The Cohen Committee took the view:

"Our survey of the business of Industrial Assurance has led us to the conclusion that excessive competition, with its almost feverish pressure for 'increase,' firstly, by the offices upon their staffs, and, secondly, by the latter upon the working-class population, is responsible for the principal defects of the business. To this competition and pressure must be ascribed the masses of uneconomical contracts (many of them of doubtful legality) into which people are induced to enter and the inordinate numbers of lapses which ensue, with the heavy losses resulting from them."

But, in the authors' opinion, "the Cohen Committee clung to the idea of reforming industrial assurance by legislative means on the one hand and, on the other, by urging amalgamation and compulsory reduction of costs." Sir Arnold Wilson and Professor Levy consider such an approach inadequate to deal with the essentials of the problem. Their conclusion is "that funeral benefits should become an integral part of the Health Insurance Scheme, as its promoters originally intended and as is the general rule in countries which have not adopted the Anglo-American system of industrial assurance."

This is a scholarly, exhaustive, and well-argued piece of work, which deserves the attention of all who have any regard for social problems. One or two comments suggest themselves. It is to be regretted that the price will put this book out of the reach of many potential readers, and it would have gained force—without losing value—had it been considerably shorter. A statistical appendix, giving details of the growth of the industry and of particular companies and societies year by year, would have been a welcome addition. But these criticisms are of secondary importance. Sir Arnold Wilson and Professor Levy have performed a valuable and courageous public service. A. T. K. G.

14.—*Report on the British Social Services.* London: "Political and Economic Planning" (P.E.P.). (16 Queen Anne's Gate, S.W. 1), 1937. 10″ × 8″. 210 pp. Price 10*s.* 6*d.* cloth, 7*s.* 6*d.* paper boards.

This volume is an exposition and review of the British public social services undertaken by the authors with the idea of obtaining a general and comprehensive view of the services as a whole and their reactions on each other. Although the report deals at some length with most of the social services, it is to be taken as preliminary only to fuller reports on most of the more important of them, and a detailed consideration of the Health Services * is stated to be now well in hand. For the purposes of the report, only those services were considered which have as their object "the enhancement of the personal welfare of individual citizens." In consequence, housing, sanitation, and similar services are excluded, and war pensions are held, for a different reason, to be outside the scope of the volume. Even with these exclusions, the total amount expended on the services included amounted in 1934 to over £400,000,000, and if workmen's compensation, war pensions, housing and other non-individual services are brought in, the expenditure for that year was in the region of £470,000,000. The above figures include the contributions of employers and workpeople to the contributory insurance schemes (health, unemployment and pension), which in that year amounted to nearly £100,000,000. The report insists too much, perhaps, on the haphazard way in which the various measures of social reform have been piled up, claiming that the form and objectives of these measures "have been indicated by temporary circumstances, financial and political considerations and by passing fashions of administrative method." All these must, of course, to some extent be taken into account when reforms that have to obtain legislative sanction are being devised, but it would not be difficult, in reviewing social legislation from the Education Act of 1870 and Joseph Chamberlain's Workmen's Compensation Act of 1897 to the great pension and insurance acts of the present century, to recognize a good deal of logic and common sense in the priority of the various reforms in point of time and in the methods devised for their administration. The report contains a sufficient and accurate (though in some cases only a brief) account of each of the social services dealt with, points out where each scheme is, in its opinion, defective or open to criticism, and puts forward in each case suggestions for improvement and extension. Hardly any of the suggestions are entirely new, and many, if not most, of them are recognized as entailing large increases in cost and fresh legislation, but quite a number of the proposals for improvement are capable of being brought about by administrative action without the tedious and hazardous process of legislation. It will never, we think, be possible to do away with all the overlapping on which the report is so severe. National social measures can never be plotted out in perfectly water-tight schemes, and nearly all social reforms impinge at some points on each other, but no doubt much improvement is capable of being effected. Perhaps the most important general proposal is that for a Permanent Statutory Committee to act " as an advisory General Headquarters Staff for planning and guiding social policy," on the lines of the Unemployment Insurance Statutory Committee. Such a committee, to be able to survey continuously and with expert knowledge all the various operations of the social services, would be an unwieldy body, and when it came to advising on and guiding social policy for Ministers and Governments, would be bound to fail in effectiveness. To deal with one fairly definite scheme like Unemployment Insurance is one thing, to deal with the whole body of social legislation would be a hard task for supermen. Attention is drawn in the report to the possibility of making the Workmen's Compensation Acts part of the public social insurance system. Attention might also have been drawn to the hardships experienced when workpeople are killed or injured during employment with firms of no substance, which have neglected to insure against their liabilities under the Acts. Compulsory insurance is now enforced in coal mining and its extension to all industries seems indicated, but the difficulty of effective enforcement among vast numbers of small employers and householders appears to be very formidable. At the same time, the premiums that insuring employers have to pay seem excessive and out of proportion to the compensation paid to workpeople in those industries where statistics are available. It is difficult, however, to see any great advantage in re-allocating the cost of this service which has long since been allowed for along with the other " overheads " of industry. W. A. B.

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* This report has now been published.

15.—*Problems of Town and Country Planning*. By Sir Gwilym Gibbon, C.B., C.B.E., D.Sc. London: George Allen and Unwin, 1937. 7¼" × 4¾". 200 pp. 5*s*.

The author, who recently retired from the Ministry of Health, has already made valuable statistical contributions on subjects within the purview of his late Department. He now turns to another of the Ministry's subjects, though on this occasion he does not approach it from a statistical standpoint (Town and Country Planning has only a short statistical history), but discusses its economic and administrative difficulties, and suggests means of overcoming them. He has shirked none of the major difficulties, even though his solution may raise highly controversial questions, such as those concerned with individual ownership of land. It would seem that without some such scheme as pooling of ownership, constructive (as distinct from regulative) town planning must be counted as impracticable.

One question on which the author's views would be valuable is not discussed in his book—namely, permissible density of population. The Ministry's model clauses, dated February 1937, mention the figure of 100 persons to the acre, reckoned on sleeping accommodation, as a standard for flats, but contemplate higher densities in the central districts, without, however, specifying any figures. The matter is important, seeing that it is possible to comply with building bye-laws, and yet to design good-class residential flats with a density of more than 650 persons to the acre. Traffic considerations alone suggest that the placing of town planning restrictions on a density of this order is necessary; but what density should be permitted and in what circumstances? The book is a model of conciseness and clarity. J. C. Sp.

16.—*The World Agricultural Situation in 1935–36.* International Institute of Agriculture, Rome, 1937. 9½″ × 6½″. 352 pp. *25 lire.*

The period from the beginning of 1935–36 to the spring of 1937, covered by this survey, was marked by signs of widespread economic revival, in which agriculture participated no less than industry. Prices tended to move upwards, and there were indications of a general, though not universal, improvement in agricultural conditions, due partly to the influence of weather, partly to Government intervention, and partly to industrial expansion.

The influence of these various factors and the problems arising from the recovery are discussed by Dr. George Pavlovsky, the Head of the Economic Section of the Institute, in the review with which the volume opens.

Not the least interesting part of this review is that in which he endeavours to set out the problems which seem to be raised by the present recovery in world agriculture. Briefly, the position may be said to amount to this. In an effort to assist agriculture—an effort which apparently could not be avoided—the Governments of practically all countries in the world have built up elaborate systems of regulation and control which make the present-day economic organization essentially different from the competitive system. In countries that import food from abroad, the home producer now enjoys a degree of protection by duties, quotas, licensing, etc., which far exceeds in efficiency anything that previously existed, even in the most protectionist countries. In exporting countries, where these methods are not applicable, other methods have been adopted, such as export bounties, the fixing of minimum prices in the home market, the reduction of costs of production, etc. In the first instance, all this was regarded as a temporary expedient, but it is increasingly evident that the complicated mechanism thus set up stands no chance of being withdrawn. Indeed, the trend of present-day development is definitely the other way—that is, towards the encouragement of economic self-sufficiency rather than towards the encouragement of economic interdependence between different nations. This tendency is stimulated by military considerations.

In these circumstances the question which the devisers of agricultural policies have to consider is, how to adapt the planning and control of agriculture to the conditions of a period, not of depression, but of revival and expansion. Quite shortly, this seems to be the problem which Dr. Pavlovsky puts forward, and his discussion of the subject is well deserving of consideration.

The revival of industrial production obviously involves the reabsorption into employment of large numbers of workers and a corresponding increase in the aggregate purchasing capacity, with a consequential demand for foodstuffs, while increased industrial production itself sets up a demand for primary products of agricultural origin, such as cotton, wool, rubber, timber, etc. In these expansionist conditions, a policy of restriction in agriculture not only ceases to be justified, but may even be dangerous, by tending to aggravate inflationary tendencies and produce an excessive rise in the prices of agricultural commodities. "The revival of agriculture and its expansion to be really beneficial and lasting should be thoroughly planned and organized in the light of the experience of the past."

"The very idea," says Dr. Pavlovsky, "of having to pilot an industry through a period of revival and expansion may seem preposterous from the point of view of economic orthodoxy, and yet it is no exaggeration to say that at the present juncture, this is one of the most vital problems with which, all over the world, those responsible for the agricultural progress of their respective countries are confronted." It involves the devising of ways and means for the levelling up of agricultural production to correspond with the increase in effective demand, which, while putting the farming industry on a reasonably remunerative basis, will not give rise to excessive profits; this, he thinks, ought to be possible by an adaptation of "those expedients of regulation and control which all Governments have learnt to use in the last few years."

From a practical point of view it may be thought that this is a counsel of perfection, especially in view of the fact that the present "control" is exercised by individual countries independently in their own interests, which are far from coinciding with the general good, but there can be little doubt that the methods of assisting agriculture which aimed mainly at raising or maintaining prices are not necessarily suited to a condition of economic expansion.

In addition to this introductory review, the volume contains a valuable chapter on the markets and prices of the principal agricultural products, and a section summarizing for the chief countries the various measures of farm relief adopted in each during the year and the economic conditions of their agriculture. R. J. T.

17.—*An Introduction to the Theory of Statistics.* By G. Udny Yule, C.B.E., M.A., F.R.S., and M. G. Kendall, M.A. Eleventh edition, revised throughout and re-set. London: C. Griffin, 1937. $8\frac{3}{4}'' \times 6''$. Pp. xiii + 570. 21*s*. net.

The first edition of this classic, a book of 376 pages, was reviewed in the *Journal* in May 1911. In the opinion of the reviewer (A. N. F.) the work "definitely resolved the doubts, whether there be a science of statistics." The same issue of the *Journal* contained a review (by J. M. K.) of the second edition of Czuber's *Wahrscheinlichkeitsrechnung und ihre Anwendung auf Fehlerausgleichung, Statistik und Lebensversicherung.* After due praise of Czuber's methods for possessing the style and lucidity given by a direct line of descent from those of the classical writers on Probability and Error, J. M. K. says, "The reader must feel that these methods have reached their limit of accomplishment, and that nothing very novel can result from attempts to perfect them further." He then contrasts these methods with recent English contributions, which, "fragmentary and often obscure or inaccurate as they now are, seem to have within them the seeds of further development, and to carry the methods of mathematical statistics into new fields." The successive editions of Mr. Yule's book, while keeping always to the original plan, have marked the stages of the development, foreseen in 1911, of the work of the English School into a classical method. Continental writers like Tschuprow and Fréchet have reconciled the old and the new. Astronomy and meteorology have adopted with profit methods first devised for biology in the wide sense of the term.

The appearance of the book has changed for the better. The page is larger, the type clearer. The chief additions are in the sections on sampling. There is a new chapter on Interpolation and tables of *t* and *z* functions. The hand of the master is visible in the Interpolation chapter, but the whole of the work of revision is good, and Mr. Kendall is to be congratulated in giving us the new without spoiling the flavour of the old. The new version is, like the previous editions, the best introduction to the subject not only for those of more limited mathematical attainments, but equally for the mathematical specialist. There is no other book so inspiring to the young research worker, teaching him the essentials of statistical theory, as distinct from the turning of the handle of a Brunsviga on the one hand or the maze of mathematical analysis on the other hand.

Reading this book, young men shall see visions and we older men shall dream dreams. L. I.

18.—*Other New Publications* *

Coote (*J. A.*). A Graphical Survey of the Canadian Textile Industries. McGill University Social Research Series, No. 4. London: H. Milford, 1936. $9\frac{3}{4}'' \times 7''$. viii + 248 mimeographed pages.

[This is a statistical source-book collating much of the information scattered through various official publications concerning the Canadian textile industry. The study consists of a large number of tables, all illustrated by charts. There is the minimum of printed matter, and it is not the purpose of the book to provide exhaustive analysis or to draw conclusions from the material, although a certain amount of background is given. The bulk of the tables are time-series going back annually to about 1915, and in some cases by decades to 1870. A number of the diagrams are quite clear, though a few where the series overlap are extremely confusing —for example, chart 22. The bar diagrams seem superfluous in a book which aims at brevity and cheapness. No attempt is made to apply mathematical technique to the figures, with one exception, when average wages are related to the percentage of female labour employed. This attempt is not very successful.

The book brings together a great deal of information of use to anyone researching on its subject, and indicates the sources from which further information can be obtained. It makes, in comparison with a collation of our own meagre statistical equipment, an astounding survey of the development of the industry.]

Davenport (*Donald H.*) and *Scott* (*Frances V.*). An Index to Business Indices. Chicago: Business Publications, Inc., 1937. $9'' \times 6''$. viii + 187 pp. $3.

[" A guide to the most important index numbers and other statistical indices that reflect the current changes in business conditions in the

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* *See also* "Additions to Library," p. 259.

United States." The first part, the Finding Index (to which a key is also included), consists of three general sections: wholesale and retail commodity prices, building construction costs, cost of living and purchasing power; Security prices and yields; General business activity, finance, labour, and production and distribution. The second part describes and classifies the different index numbers and indices. As is explained in the preface, the book makes no claim to include all indices of business, but it does contain "all published series which the authors consider to have sufficient general significance for the analysis of current business conditions."]

Stamp (*L. Dudley*) and *Beaver* (*S. H.*). The British Isles: a geographical and economic survey. With contributions by Sir Josiah Stamp and D. K. Smee. 2nd. ed. London: Longmans, 1937. 8½" × 5¾". xii + 719 pp. 25*s*.

[The first edition of this book, published in 1933, was noticed in the *Journal*, vol. xcvii, p. 513. In the present edition the chapters on manufacturing industries, particularly the heavy industries, have been considerably revised, and a number of small revisions have been made throughout the book, more particularly in the chapters on iron and steel, and in some of the smaller sections: on soils, hydro-electric power, artificial silk, and Irish commerce. Some of the maps have been re-drawn and many graphs and tables revised. Two valuable comparative tables of industrial employment have been added to the chapters on the metallurgical industries, also some new summary tables of industrial and other occupations.]

The Northern Countries in World Economy. Denmark, Finland, Iceland, Norway, Sweden. Published by the Delegations for the Promotion of Economic Co-operation between the Northern Countries, 1937. 237 pp. 8¾" × 6".

[At the various conferences held by the above-named delegations since their establishment by their respective governments in 1934 (they have met in each of the northern capitals in turn) a great need was felt for a general survey of this kind. An editorial committee was therefore set up, and the present publication is a result of its work. It not only deals with the common economic problems of the Northern Countries and with co-operation between them, but is also a manifestation of that spirit of co-operation. The book opens with short sketches of each of the five countries, their chief geographical and demographic characteristics, and the second chapter is devoted to the basic elements in their economic structure. There follow chapters on agriculture; fishing and whaling; forestry, woodworking, mining, metal quarrying, and other industries; the Northern Countries as producers and as consumers; shipping; communication and the tourist industry; the international balance; commercial policy; economic co-operation. These chapters are mainly descriptive, but are supported by figures in a special section of thirty-two tables.]

STATISTICAL NOTES

(1) British Official Statistics

On page 230 we give our usual table summarizing the oversea trade of the United Kingdom for the years 1936 and 1937. There was an all-round increase in imports, exports and re-exports last year to the highest figures in each case since 1930. Prices of imports rose more than those of exports, with the result that there was a very substantial increase (£86 million) in the excess of imports over exports of merchandise, this adverse balance in 1937, amounting to £432 million, only being exceeded by those in 1917–19 and in 1926, when our export trade was affected as a result of the coal stoppage and there were heavy imports of coal. The excess of imports last year was £26 million greater than in 1931, when imports were swollen in anticipation of the tariff.

In value, *imports* rose by 21 per cent. to £1,029·1 million and re-exports by 24 per cent. to £75·2 million, making the rise in retained imports £166·9 million (21 per cent.); exports of United Kingdom goods increased by £81·0 million (18 per cent.) to £521·6 million. The increase in the volume of retained imports was 6 per cent. and of exports of United Kingdom goods 9½ per cent. Whereas in 1936 imports rose in volume more than exports, the reverse was the case in 1935, and in comparison with either 1933 or 1934 the increase in the volume of exports has exceeded that of retained imports. The proportion of imports consigned from British countries (39·4 per cent.) was the highest yet recorded, but for exports the proportion (48·3 per cent.) was appreciably lower than the record figure of the previous year.

Following the increase of £27·3 million in 1936, retained imports of food, drink and tobacco rose last year by £49·3 million to £419·2 million. The increase in value was due almost entirely to price changes, there being an increase of only 1 per cent. in volume, as estimated in the *Board of Trade Journal* for January 27th. All cereals rose in average value to the highest figures since 1929, though apart from maize average values fell somewhat during the second half of the year. Meat also rose in price, and for mutton and lamb and bacon the average values recorded were the highest since 1930. Retained imports of wheat declined by 5 per cent. to 95·1 million cwts., the lowest figure since 1921; imports of flour increased by 2 per cent. There was a decline of 1 per cent. for barley and 4 per cent. for maize from the high figures recorded the previous year. For beef, mutton and lamb and bacon there was an appreciable increase of 5 per cent. or more in each case in the quantities imported.

A decrease occurred in imports of butter, and imports of apples were abnormally low. Apart from these, imports of the important descriptions of dairy produce and fruit were larger last year than in 1936. Retained imports of tea increased, though there was little change in the quantity entered for home consumption. The quantity of unrefined sugar imported exceeded that in any earlier year except 1932, but the quantity entered for home consumption was slightly less than the record reached in the previous year. Retained imports of tobacco were the highest apart from 1919 and the quantity entered for home consumption last year has never been exceeded.

Retained imports of raw materials in 1937, valued at £278·4 million, exceeded those in 1936 by £63·4 million. The value was the highest since 1929, while the volume of imports exceeded the record figure of 1936 by 9 per cent. This confirms the indications of the numbers employed and the index of production that there was greater industrial activity in this country last year than at any previous period in our history. The increase was widespread, there being a record importation of timber, groundnuts, whale oil, hides, asbestos, and silk. Retained imports of iron ore were the highest since 1913, of pyrites since 1920, of hemp since 1920, and of cotton since 1925. For wool there was a considerable decline from the high figure of the previous year.

The rise in the value of retained imports of articles wholly or mainly manufactured amounted to £53·7 million (27 per cent.), of which nearly one-half resulted from higher prices. The increase was mainly in goods used as materials for industry. Retained imports of refined petroleum and plywood, and of lead, zinc and nickel all exceeded the record figures of the previous year. The quantity of machinery imported constituted a record, very largely owing to larger imports of machine tools and rolling-mill machinery necessitated by the increased activity in the heavy industries, to which the rearmament programme has contributed. There was a heavy increase in imports of iron and steel, primarily pig iron, imports of which exceeded those in any earlier year. The number of motor cars imported was higher than in any year since 1927.

The quantity of coal exported rose to 40,352,000 tons, the increase compared with the abnormally low figure of the previous year being 17 per cent. The bulk of the increase was due to the resumption of exports to Italy and to larger shipments to France. The proportion of the total value of British exports represented by coal fell year by year from 8·9 per cent. in 1931 to 6·6 per cent. in 1936,

Movements and Classes	Twelve Months ended December 1936	Twelve Months ended December 1937	Increase (+) or Decrease (−)
Imports, c.i.f.—	£'000	£'000	£'000
Food, drink and tobacco	381,567	432,373	(+) 50,806
Raw materials and articles mainly unmanufactured	247,941	315,345	(+) 67,404
Articles wholly or mainly manufactured	212,678	274,985	(+) 62,307
Other articles	5,566	6,362	(+) 796
Total Imports ...	847,752	1,029,065	(+)181,313
Exports, f.o.b.—			
United Kingdom Produce and Manufactures—			
Food, drink and tobacco	35,585	38,780	(+) 3,195
Raw materials and articles mainly unmanufactured	51,307	64,652	(+) 13,345
Articles wholly or mainly manufactured	340,778	404,839	(+) 64,061
Other articles	12,935	13,324	(+) 389
Imported Merchandise—			
Food, drink and tobacco	11,676	13,181	(+) 1,505
Raw materials and articles mainly unmanufactured	32,935	36,914	(+) 3,979
Articles wholly or mainly manufactured	15,833	24,443	(+) 8,610
Other articles	325	628	(+) 303
Total Exports ...	501,374	596,761	(+) 95,387
Bullion and Specie—			
Imports	331,352	315,367	(−) 15,985
Exports	104,692	225,326	(+)120,634

Movements of Shipping in the Foreign Trade—	Number of Vessels	Thousand Tons Net	Number of Vessels	Thousand Tons Net	Number of Vessels	Thousand Tons Net
Entered with cargoes—						
British	24,324	38,055	24,926	39,289	(+) 602	(+)1,234
Foreign	26,108	29,360	28,033	31,131	(+)1,925	(+)1,771
Total entered ...	50,432	67,415	52,959	70,420	(+)2,527	(+)3,005
Cleared with cargoes—						
British	29,385	34,302	30,992	35,983	(+)1,607	(+)1,681
Foreign	21,006	22,516	23,777	25,405	(+)2,771	(+)2,889
Total cleared ...	50,391	56,818	54,769	61,388	(+)4,378	(+)4,570

but recovered in 1937 to 7·2 per cent. Exports of iron and steel rose last year by 17 per cent. to 2,576,000 tons, the highest figure since 1930, practically all markets taking increased quantities. The Board of Trade have calculated that, adding together the value of the exports of iron and steel and manufactures thereof, iron ore and scrap, cutlery, hardware and tools, machinery and vehicles (except rubber tyres), the contribution to the total value of British exports was 24·4 per cent. in 1929, 25·2 per cent. in 1935, 25·4 per cent. in 1936 and 27·2 per cent. last year. The proportion represented by these ferrous metal goods was higher last year than in any year since 1921. The quantity of machinery exported was the highest since 1930, as it was for iron and steel, there being an increase of 15 per cent. compared with 1936 mainly as a result of a recovery in exports of textile machinery and larger exports of boilers and agricultural tractors. The number of motor cars and chassis exported (105,300) constituted a record for the fifth year in succession, the increase last year being 16,800, and for the third year in succession a record number of pedal cycles (831,000) were exported, the increase being 60 per cent., and exports of aircraft attained a record value (£3,676,000). There was a further rise last year in exports of ships and boats, the increase being in warships, as there also was in railway rolling stock, though not in locomotives. The value of cutlery and hardware exported has risen steadily since 1931, and last year was the highest yet recorded, apart from 1920, when prices were extremely high.

As regards textiles, it is stated in the *Board of Trade Journal* that in 1929 textile exports formed 31·3 per cent. of the total value of British exports, but this proportion has been lower in recent years, being 27·5 per cent. in 1935, 27·6 per cent. in 1936 and 26·2 per cent. in 1937. This decline was due to reduced exports of cotton goods, which formed 18·7 per cent. of the total in 1929, but only 14·4, 14·2 and 13·3 per cent. in 1935, 1936 and 1937. Exports of wool and manufactures thereof, on the other hand, rose from 8·6 per cent. of the total British exports in 1929 to 9·1 per cent. in 1935 and 1936, but fell to 8·5 per cent. in 1937. Exports of cotton yarns were the largest since 1929, and the decline shown in recent years in exports of cotton piece-goods was arrested, the quantity exported increasing from 1,917 to 1,922 million square yards. Exports to India, amounting to 356 million square yards, were the lowest for many years. The largest increases were in exports to the Dutch East Indies, Australia and British Malaya, possibly related to reduced imports into those countries from Japan. Exports of artificial silk tissues exceeded the previous year's record by 20 per cent., carpets were exported in larger quantity than in any year since 1924, and woollen and worsted tissues, jute piece-goods and cordage since 1929. Linen piece-goods declined somewhat from the high figure of the previous year, and woollen and worsted yarns were lower than in any year since 1921.

Among other goods the expansion was very widespread. For a number of commodities, among which may be mentioned glass, electrical goods and apparatus, sodium compounds, paints and colours, leather, paper and cardboard, books and linoleum, exports exceeded those in any year since 1929. Exports of nickel constituted a record for the third year in succession. Exports of ammonium sulphate, which had declined almost continuously since 1929, showed a very marked increase last year. The quantity of spirits exported was higher than in any year since 1916, of beer since 1929, and of cigarettes since 1930.

Imports of *bullion and specie* declined by £16 million to £315 million, while exports rose by £121 million to £225 million. The excess of imports last year, £90 million, was accordingly much less than in the previous year, when it reached the abnormal figure of £227 million. Of the excess of imports last year, about £10 million represented net imports of silver, mainly from Hong Kong. Gold to the value of £116 million was imported from France, and imports from the Union of South Africa amounted to £80 million, while of the exports the United States took £169 million out of £216 million.

The rise in the general level of *wholesale prices*, which was fairly continuous during the whole of the year 1936, was maintained during the first half of 1937 and reached its height in the month of July, by which month the index number of the Board of Trade had registered an advance of 10·6 per cent. compared with December 1936. From that month, however, general prices declined gradually during the remainder of the year and in December 1937 had fallen 3½ per cent. as compared with July, and were only 6·7 per cent. in advance of those prevailing in December 1936. The decline was most marked in non-ferrous metals and in textiles, which are the only groups of materials in which prices are now below the level of a year ago, although basic materials as a whole have also declined. On the other hand, iron and steel prices have continued to advance steadily, and are now about 55 per cent. above the prices ruling in the middle of 1932, their lowest point. Coal prices also hardened throughout the year, apart from slight seasonal changes, and are 17 per cent. above the prices of a year ago, and well above the low prices prevailing during the whole of the six years 1930–1935, with no signs of any recession. The prices of building materials remain fairly steady, and show little signs of breaking away. Apart from seasonal fluctuations, food prices continue to appreciate on the whole, although there was some decline in December from the high prices of butter that obtained in the two or three previous months, and the price of cocoa, which had advanced 80 per cent. during 1936 and had continued high during the first three months of 1937, fell about 40 per cent. by the end of the year. The price of rubber, which averaged 11·86*d.* per lb. in March 1937, fell steadily from that month, and in December 1937 averaged 7·25*d.* per lb. In January of this year it was announced that the export quota would be considerably reduced.

No doubt the recession of industry and the fall of prices in the United States have had a strong influence on prices in Great Britain, especially those of primary products, but it was not to be expected that the high prices of many products that obtained in the first three months of 1937, to a great extent due to speculative efforts, could be maintained for any considerable time. The Board of Trade index numbers of wholesale prices from July 1937 onwards are given below :—

Averages for the Year 1930 = 100

Date	Total Food	Total not Food	All Articles	Basic Materials	Intermediate Products	Manufactured Articles	Building Materials
July, 1937	102·9	116·1	111·5	128·5	113·1	115·2	105·7
Aug. ,,	102·8	115·9	111·4	128·5	112·4	115·4	105·6
Sept. ,,	103·7	115·2	111·2	125·5	111·6	115·3	105·5
Oct. ,,	105·3	113·2	110·6	118·8	110·1	115·0	105·3
Nov. ,,	104·5	110·4	108·5	110·4	108·6	114·4	105·0
Dec. ,,	104·4	109·2	107·6	106·9	107·7	114·1	105·0
Dec., 1936	*99·3*	*101·5*	*100·8*	*109·8*	*100·4*	*100·9*	*100·3*
,, *1935*	*88·6*	*92·9*	*91·5*	*93·8*	*90·0*	*96·2*	*95·1*
Year 1937	*102·2*	*112·0*	*108·7*	*122·9*	*108·9*	*111·4*	*104·2*
,, *1936*	*91·7*	*95·7*	*94·4*	*98·9*	*93·3*	*98·2*	*96·7*
,, *1935*	*86·8*	*90·1*	*89·0*	*88·3*	*87·6*	*94·9*	*93·8*

The figures for certain of the other British index numbers of wholesale prices and the official index numbers of France, Germany and the United States, are given below for comparison :—

Date	Board of Trade (1930 = 100)	*Economist* (1927 = 100)	*Statist* (1866–77 = 100)	*The Times* (1913 = 100)	France (*Stat. Générale*) (July 1911 = 100)	Germany (*Stat. Reichsamt*) (1913 = 100)	U.S.A. (Bureau of Labor) (1926 = 100) †
Dec., 1936	100·8	79·3	98·6	120·8	499	105·0	83·6
July, 1937	111·5	84·7	124·2	131·8	580	106·4	87·5
Dec., 1937	107·6	77·2	114·6	123·9	601	105·5*	81·9

November, 1937. † Average of weekly prices.

It will be seen that all the index numbers except that of France show a decline between July and December 1937. The increase in the French number is no doubt due to the continued difficulties of the franc.

The rise in *retail prices* which had been fairly continuous during 1936 continued throughout 1937, and the Ministry of Labour's index number of retail prices of articles of working-class consumption was at January 1st, 1938, and had been for the three preceding months, higher than in any month since March 1930. At January 1st, 1938, the number stood at 159 (July 1914 = 100), and at the beginning of each of the three months October, November and December 1937, at 158, 160 and 160 respectively. Over the year 1937 the percentage increase was 5·3, compared with an increase of 2·7 per cent. in 1936. The lowest point touched by this index number since the war was in May and June 1933, when it stood at 136, and the number shows an advance of 16·9 per cent. as compared with those two months. Rents showed no advance during the year, but there was an appreciable increase in the cost of clothing, and there were smaller increases in the cost of fuel and some smaller items. The index number for food only advanced from 136 at January 1st, 1937 to 145 at January 1st, 1938—a rise of 6·6 per cent. As in the case of the general index number, that for food prices was higher at the end of 1937 than in any month since March 1930, and shows an advance of rather more than 27 per cent. since its lowest point in May and June 1933. As compared with January 1937, practically all the principal articles of food, except potatoes, margarine and fish, showed appreciable increases in price, but fish still costs more than double its price before the Great War. The most important advances in price were for meat, butter, cheese, eggs, and to a less extent bread and tea. Milk is now almost double the price that it was in 1914. The Ministry of Labour's index numbers for recent months are given below, the prices at July 1914 being taken as 100.

	Aug. 1st, 1937	Sept. 1st, 1937	Oct. 1st, 1937	Nov. 1st, 1937	Dec. 1st, 1937	Jan. 1st, 1938	Jan. 1st, 1937	Jan. 1st, 1936
Food Prices ...	140	140	143	146	146	145	136	131
All Items (food, clothing, rent, fuel, etc.) ...	155	155	158	160	160	159	151	147
All Items (a year earlier)	146	147	148	151	151	151	147	143

Rates of wages continued to advance during 1937, and the net effect of all the *Changes in Wages* reported to the Ministry of Labour during the year was a weekly advance of about £780,000 in the weekly full-time rates of wages of the 5,110,000 workpeople affected.* This is the fourth year in succession during which net rises in wages have occurred, net reductions having been recorded during the previous seven years 1927–33. The principal increases were in the coal-mining industry, the metal, engineering and shipbuilding trades, textile and clothing trades and the building and transport industries. There were also some increases in wages in agriculture and certain other employments. Only about 4,400 workpeople were reported to have suffered reductions in wages during the year. The Ministry of Labour estimates that in all the industries (including agriculture) for which information was available, the average level of full-time rates of wages rose during 1937 rather more than 4 per cent. compared with 3 per cent. in 1936 and 1½ per cent. in 1935.

About 388,000 workpeople had their hours of labour reduced during 1937 to the extent of about 2½ hours per week.

The net number of workpeople involved in *trade disputes* causing stoppages of work in 1937 was about 418,000, and about 205,000 workpeople were thrown out of work at the establishments where the disputes occurred, but were not themselves parties to the disputes. The total number of working days lost at these establishments owing to the disputes was 3,417,000, compared with 1,829,000 days lost in 1936. The disputes involving the greatest amount of lost time occurred in the coal-mining industry, where nearly 1,500,000 days work were lost in 457 large and small disputes. Owing to the strike of 24,000 omnibus drivers and conductors in London in May 1937, about 565,000 working days were lost, and strikes of apprentices in engineering and shipbuilding works on Clydeside and in Lancashire, Cheshire and Yorkshire caused the loss of nearly 400,000 days.

The upward trend of *agricultural prices*, which has been recorded since 1933, was continued in a marked manner in 1937, when the general index number of the prices of agricultural produce as calculated by the Ministry of Agriculture rose by 11 points to 133 (1911–13 = 100). When allowance is made for deficiency payments under the Wheat Act and for the cattle subsidy, the general index for the year is increased by 4 points to 137. This is the highest point since 1929, when it stood at 144.

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* Excluding changes in the wages of agricultural labourers, domestic servants, Government employees, shop assistants and clerks.

The figures for the past six years are given below, the first series giving the general index calculated on prices alone, and the second or revised series including the additional payments referred to above.

	1932	1933	1934	1935	1936	1937
General Index	112	107	114	117	122	133
General Index Revised	114	111	119	123	127	137

In 1937 increased prices were recorded for all commodities except potatoes, vegetables and hops, the latter being unchanged.

A note in the September issue of the *Journal of the Ministry of Agriculture* mentions the extent to which information of a statistical nature is supplied by farmers on an entirely voluntary basis. For example, in several recent years farmers have been asked to make a special return of the numbers of cattle, sheep, and pigs in December, in addition to the annual compulsory return in June, and the proportion of completed returns received has amounted to over 70 per cent. The estimates based on so large a sample as this can evidently be accepted as accurate within a very small margin. Again, in the case of a return sent out this year to 370,000 farmers more than 240,000 replies were received within three weeks. In the same way, most of the voluntary enquiries carried out by the Ministry in connection with the Censuses of Agricultural Production have brought in replies from well over one-half the farmers of the country, and bearing in mind the frequently somewhat recondite character of the questions asked, this proportion must be regarded as surprisingly high.

The success which has attended the efforts of the Ministry of Agriculture to collect information as to the agricultural industry through the medium of large samples voluntarily supplied, suggests that some similar methods might well be applied to the collection of information in regard to other industries.

The decline in *unemployment*, which had been practically continuous from January 1937, was arrested in September. During the remainder of the year the amount of unemployment increased appreciably from month to month, and the proportion unemployed in the insured trades in Great Britain and Northern Ireland at the middle of December 1937 (12·2 per cent.) was greater than at the corresponding date in 1936 (12·0 per cent.). For the whole year 1937, however, the average rate (10·9 per cent.) was appreciably lower than that for 1936 (13·1 per cent.), and was also lower than in any year since 1929. Moreover, taking the year as a whole, unemployment showed a decline in all districts except in Northern Ireland, where the proportion unemployed rose from 22·6 per cent. in 1936 to 23·3 per cent. in 1937. In Wales, which up to 1936 had shown the largest proportion of unemployment, the rate dropped from 29·4 to 22·3 per cent. Unemployment during the year was lowest in London, the South-Eastern area and the Midlands (6·3 per cent., 6·7 per cent., and 7·2 per cent., respectively), and highest in North Ireland, Wales and in the Northern area (17·9 per cent.). It is difficult to account for the long-continued high rate of unemployment in Northern Ireland. For the last eight years the average rate has been 24·8 per cent. and for only three months of that time was the rate below 20 per cent.

In 56 out of the 102 groups into which the Ministry of Labour divides up the insured trades for statistical purposes, an increase in unemployment is shown in December 1937 as compared with December 1936. The increase is not considerable in many cases, but it is quite appreciable in nearly all the textile trades and in several of the clothing trades. In the remaining 46 industries employment was generally slightly better than at the end of 1936. There was a noticeable improvement in coal-mining, where employment has been much better of late, apart altogether from seasonal changes. Employment was also better in marine engineering and shipbuilding and at coke-ovens and blast-furnaces. The only industries in which the rate of unemployment was in excess of 20 per cent. at December 1937 were public works construction (41·8 per cent.), shipping (25·5 per cent.), jute (26·4 per cent.), linen (24·5 per cent.), dock labour (24·2 per cent.), stone-quarrying (23·2 per cent.), hat- and cap-making (23·6 per cent.), shipbuilding (22·9 per cent.), building (21·1 per cent.), and textile bleaching, etc. (20·2 per cent.). Rather more than 2,000,000 workpeople are insured against unemployment in these industries.

The average number of insured persons * in employment in Great Britain during 1937 was 11,496,000, compared with 10,912,000 in 1936. The numbers in employment increased during the first eight months of the year, but thereafter declined, and at the end of the year the number had fallen to 11,437,000. The number was probably at its maximum at the end of August, but on account of a revised and improved method in dealing with the records of unemployment at the Ministry of Labour's Employment Exchanges, it is not possible to say how far earlier figures maybe affected.

The percentage unemployed among persons employed in agriculture during 1937 was 4·5 per cent. For males the rate was 4 per cent.

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* Excluding agricultural workers.

and for females 14 per cent. At December 13th, 1937, the percentage was 8·3 per cent.

The number of workpeople, aged 14 to 64 (insured and uninsured), on the registers of the employment offices of the Ministry of Labour in Great Britain are given below for the last six months of 1937.

Date	Wholly Unemployed	Temporarily Stopped	Persons normally in Casual Employment	Total
July 26th, 1937 ...	1,069,180	246,615	63,664	1,379,459
Aug. 23rd, " ..	1,088,885	205,371	64,365	1,358,621
Sept. 13th, "				
Old Basis	1,118,905	203,939	65,756	1,388,600
New Basis ...	1,090,967	191,737	56,500	1,339,204
Oct. 18th, 1937 ...	1,159,613	176,337	54,299	1,390,249
Nov. 15th, " ...	1,227,600	216,806	54,797	1,499,203
Dec. 13th, " ...	1,283,604	324,779	57,024	1,665,407
Dec. 14th, 1936 ...	*1,365,035*	*194,841*	*68,813*	*1,628,719*
" *16th, 1935* ...	*1,585,990*	*205,574*	*77,001*	*1,868,565*

The highest number on the registers in any December was 2,723,287 at December 19th, 1932.

2. Other Statistics

There was a gradual decline in the general *Value of Stock Exchange Securities* throughout 1937, broken only about the middle of December by a slight recovery in the prices of a number of Variable Dividend Securities, chiefly of a speculative kind. As measured by the index number published in the *Bankers' Magazine,* the fall in market values between December 1936 and December 1937 was from 133·1 to 121·2 (values in December 1921 = 100) or about 8·9 per cent. The fall was least in Fixed Interest Stocks (5·3 per cent.) and greatest in Variable Dividend Securities (16·1 per cent.). Over the previous twelve months values had increased 5·3 per cent. and though the more or less speculative stocks continued to rise during January and February 1937, their influence was not sufficient to outweigh the general decline which began to be apparent in January. Compared with December 1936 all the 34 classes of securities showed a decline in December 1937. The decline was greatest (over 40 per cent.) in United States and other Foreign Railway Shares, which lost all the improvement made during 1936. Rubber and copper shares fell away more than 30 per cent. and iron, steel and coal shares lost a large proportion of what they had recovered in the previous twelve months. British Railway Preference and Ordinary stocks declined nearly 10 per cent. during 1937, as compared with improvements of 17 and 37 per cent., respectively, in 1936. The decline was least in Colonial Government and Corporation Stocks and in Colonial Railways, but tea companies' shares and those of electric lighting and power companies receded only slightly.

The marked rise in the rates for *shipping freights* which characterized the last half of 1936 was continued throughout the first nine months of 1937, and in September 1937 freight rates, as measured by the index number of the Chamber of Shipping, were higher than in any year since 1921, and nearly 90 per cent. in excess of the average rates for 1936. During the last three months of 1937 rates declined somewhat steeply, and in December 1937 the index number (29·54) for the month (rates in 1920 = 100) showed a decline of nearly 7 per cent. compared with December 1936. The average for the year 1937, however, was more than 50 per cent. above that for 1936, and higher than in any year since 1921. During the year the rates obtainable were in almost every case considerably higher than the minimum freight rates in those trades where minimum freight rate schemes operate. The Government subsidy for tramp shipping (at the maximum £2,000,000 a year) did not operate in 1937, as under its terms nothing was payable so long as the average level of freights was above that of 1929. In 1937 the average level of freights was over 40 per cent. above the average rate for 1929, and in one month (September) was as much as 72 per cent. in excess of the average rate. The subsidy will not be available for tramp shipping beyond 1937.

Over the ten months February to November 1937 the value of *retail sales* show an increase of 7·6 per cent. over those for the corresponding period of 1936, according to the statistics prepared by the Bank of England in conjunction with the Association of Retail Distributors. These statistics, which are based on monthly returns from Departmental Stores, Multiple Shops, Cooperative Societies and independent retailers, show that sales of food and perishables increased 9·2 per cent., and those of other merchandise increased 5·8 per cent. Some considerable proportion of this latter increase is no doubt due to the advance in food prices, and not to sales of increased quantities, as the increase in working-class food prices, according to the Ministry of Labour's index number, showed an advance of 7·3 per cent. in 1937 over the corresponding period in 1936. The two sets of figures are not, of course, strictly comparable, as the Bank of England Statistics probably comprise a large amount of purchases by middle-class households. The index number of retail sales (average daily sales in 1933 = 100) for the ten months February to November 1937 was 121·5, compared with 112·8, 106·0, and 100·4 in the corresponding periods of 1936, 1935 and 1934, respectively. This index number reaches its height each year in the period November to January, and in November 1937 it was higher at 131 than in any November since its preparation.

There was some improvement in employment in the Irish Free State in 1937, and it was on the whole better than in any of the years 1934–36. During the last two years Orders have been in force restricting for certain months in the year the eligibility for unemployment assistance of a certain class of persons living in rural areas, but when allowance has been made for these there is still evidence of an appreciable improvement over the earlier period referred to.

Employment in Germany improved greatly during 1937, and the numbers registered as unemployed at the employment exchanges from June to November were only about 50 per cent. of those registering at the corresponding dates in 1936. The numbers increased at the end of December 1937 to 994,590, as compared with 572,600 in November, but was still much below the figure (1,479,000) for December 1936. The increase in December 1937 was due to some considerable extent to the very severe weather prevailing at the end of the month. About 578,000 of those unemployed at the end of December 1937 were in receipt of unemployment benefit, compared with 896,000 in December 1936.

In France employment improved considerably during the year in spite of the numerous trade disputes as regards wages and hours of labour. The returns of the special monthly enquiry showed continued improvement as compared with the corresponding periods in the previous year, but the index number representing the numbers employed by the undertakings covered by the returns was at December 1st, 1937, only 79·5 per cent. of the number at December 1st, 1930.

In Holland, Belgium and Switzerland employment improved generally, but in Holland the proportion unemployed is still considerable. In the Scandinavian countries there has been very little change, although in Denmark there were some slight signs of improvement. In Austria, Hungary and Poland employment was slightly better, especially in the later months of 1937.

In the United States there was a noticeable decline in employment during the later months of 1937, but the statistics of unemployment are not very easy to interpret. According to the American Federation of Labour, about 8,491,000 persons were unemployed in October 1937, which is not much less than the number it estimated for October 1936 (8,894,000). The National Industrial Conference Board gives the number for the same month as 6,355,000, compared with 7,464,000 in October 1936. A Census of unemployment has recently been carried out by the Federal Government relating to the period November 16th to 20th, 1937. The census was a voluntary registration, through the post, of unemployed persons between the ages of 15 to 74, and it was checked to some extent by a house-to-house enumeration in selected areas. The number registering themselves as unemployed was 7,822,912, of whom 5,826,213 were males and 1,996,699 females. On the basis of the figures obtained by the special enumeration it was estimated that a complete house-to-house census would have recorded about 10,870,000 persons as unemployed or working on emergency relief schemes. As the number on relief schemes is variously put as from 2,000,000 to 3,000,000 it would appear that the actual number of unemployed is in the region of 8,000,000, but it is not clear that the number does not include many to whom "unemployment" is a status depending on their current inclinations and temporary economic conditions.

Employment in Canada throughout 1937 was fair on the whole, and considerably better than in 1936. In New Zealand employment improved slightly, but remained somewhat slack. In Australia there was a marked improvement in 1937.

Statistics of railway revenue for the month of September 1937 and operating results for the four weeks ended October 2nd are given in No. 214 of the Ministry of Transport Returns. Gross revenue for the nine months ended September 30th was well in advance of the corresponding period in 1936, passenger traffic (exclusive of season tickets) having produced £46,152,679 or 6·6 per cent. above the previous year's figure, and freight traffic £71,242,098, an increase of 4·62 per cent. Passenger journeys for the nine months were 1,030,849,000 (including 333,954,000 journeys over the lines of the London Passenger Transport Board), having risen by 6·7 per cent. All classes of traffic contributed to this increase, substantial improvement being recorded in journeys at ordinary fares (11·6 per cent.), day and half-day excursions (5·3 per cent.), monthly and period excursions (4·7 per cent.) and workmen's journeys (4·3 per cent.). Receipts per passenger journey were 10·75*d.*, a slight fall of 0·1*d.* on 1936, but for the main-line companies only, the figure was 14·36*d.*, as compared with 14·18*d.* in 1936. Freight tonnage rose by 6·8 per cent. to 227,557,000, all classes having increased by about 7·0 per cent., with the exception of live stock, which recorded a decrease of 7·6 per cent. The average receipts per ton of freight fell from 6*s*. 5*d*. to 6*s*. 3*d*., due to a relatively higher improvement in the receipts from low-rated traffics, the average length of haul being unchanged at 58·0 miles.

The operating statistics reflect increased expenditure called for by the improved traffics, passenger train mileage having risen by 1·7 per cent. to 245,058,000 and freight-train mileage by 3·7 per cent. to 107,068,000. Heavier loading is indicated by increases in the mileage of assisting engines of 10·0 per cent. for passenger and 2·0 per cent. for freight trains. The average net train load of freight at 130·51 tons was 4·63 tons greater than in the corresponding period, and notwithstanding a slight fall in the rate of movement at 8·77 train-miles per train-hour, the ton-mileage per engine-hour rose from 460·7 to 467·1.

The return also gives statistics in respect of the operation of 110 selected marshalling yards during the four weeks ended October 2nd, but as comparisons between the yards are precluded owing to widely varying circumstances, these tables would be improved by the inclusion of the corresponding statistics for each yard in respect of previous years.

The gross traffic receipts published by the companies for the 52 weeks ended January 2nd, 1938, are as follows :—

	Receipts	Increase on Previous Year	
	£	£	Per cent.
Great Western (3739 miles)	27,651,000	1,317,000	5·0
L.M.S. (6867 miles)	66,210,000	2,772,000	4·4
L.N.E. (6315 miles)	48,552,000	2,286,000	4·9
Southern (2147 miles)	21,649,000	731,000	3·5
Total	164,062,000	7,106,000	4·5
London Transport (27 weeks)	15,163,700	10,300	0·1

The October Crop Bulletin of the International Institute of Agriculture states that after three years of very poor crops, the 1937 *world wheat production* is reported as very good on the whole, and larger than the probable consumption of the 12 months ending August 1938. This is largely due to an increase in the area, which amounted to a total of 267,400,000 acres, as compared with 248,600,000 acres in 1936; this figure represents a rise of 7 per cent., and is about 6 per cent. above the previous five-year average; it is also the highest total hitherto recorded. Almost the whole of the increase is due to an extension of the wheat fields of North America, chiefly the United States.

The total production is estimated at 3,840 million bushels, but this is necessarily provisional, as the harvests of countries in the southern hemisphere were not gathered at the time the estimate was made. It is a figure much in excess of the totals of the three preceding years, which have been rather over 3,500 million bushels. Although the above figure of 3,840 million bushels is provisional, it may well be fairly near the final estimate; experience of previous years shows, however, that the October estimate made by the Institute is usually lower than the final estimate, though the difference between the two has fallen in the last few years from 6 per cent. in 1933 to little more than 1 per cent. in 1936.

As already mentioned, the good total output this year is due principally to the larger area. Actually the season taken as a whole was unfavourable, and the average of the estimated yields per acre, though approximately comparable to the years 1934–6, is decidedly below some earlier years. It is to be noted that all the above figures exclude the U.S.S.R., China, Iran and Iraq, for which no statistics are available. The supplies of wheat likely to be available in 1937–38 from the principal *exporting countries* after providing for their home requirements, amount to 770 million bushels, a figure 80 million bushels or 11 per cent. higher than that of last year, but distinctly lower than the average of the five preceding years (1,060 m. bus.). Exports from Canada are likely to show a heavy fall as a result of the drought, but the return of the United States to the ranks of wheat suppliers will more than compensate for this.

The quantities necessary to cover the probable requirements of *importing countries* during the 1937–38 season, according to the information at present available, are estimated at 420 million bushels for Europe and 115 million bushels for extra-European countries, making a total of 535 million bushels. This figure compares with 602 million in 1936 37, but is slightly larger than the total in 1935–36 (502 m. bus.), which was the smallest recorded for a long series of years.

From these data it is concluded that the exportable wheat stocks remaining in hand at the end of the season after meeting all demands will undergo an increase of 130 million bushels in the course of 1937–38. These estimated stocks declined each year from August 1st, 1933, when they stood at 609 million bushels, till August 1st, 1937, when the calculated reserves amounted to only 105 million bushels; with the addition now in sight they should reach 235 million bushels in August 1938, a level approximately equal to what was regarded as normal before the great wheat crisis. These figures and those relating to exports and imports cover all countries, including the U.S.S.R., China, etc.

The *Statistics of Failures* in the United Kingdom and Ireland during the year 1937, issued annually by Mr. Richard Seyd, again show a decrease in the total number, namely, 5,579, the fewest recorded since 1921. Of this number 103 were in Southern Ireland. Of the failures 438 occurred in the financial, wholesale, and manufacturing classes, 449 in the professions, and 4,692 in retail trades and working classes; 208 of the 438 in the first category were in London, and the largest number of failures in this class (108) was among manufacturers and merchants of woollen and silk textiles, commission agents, with 40 failures, coming next in order. In the professional class the highest figures are those of auctioneers, house-agents and surveyors (37), and surgeons, physicians, and dentists (34). In retail trades the largest numbers were builders (588), drapers (254), plumbers, etc. (236), wireless dealers (131). There were 315 failures among farmers.

In addition to the failures 1,875 Limited Companies were wound up voluntarily, 477 in the wholesale, etc., trades, 48 among the professional classes, and 617 in the retail trades.

CURRENT NOTES

THE National Bureau of Economic Research in the United States, convinced that the series of collapses in various kinds of financial markets in 1929–33 showed "the need for much more fundamental research into financial problems," appointed a Committee to examine the whole subject and, in conjunction with the Association of Reserve City Bankers, has published their Report under the title *A Program of Financial Research* (1937 : Macmillan, xi + 81 pp., 4*s.* 6*d.*). The Committee recommend four major projects : "1. A Comprehensive Survey of the Financial Structure. 2. An Investigation of the Effects of Legislation and of Public Supervision of Credit. 3. A Review of Credit Standards of Financial Institutions in the Fields of : (*a*) Consumer Credit; (*b*) Real Estate Credit; (*c*) Investment Credit. 4. A Study of the Composition and Behaviour of Bank Deposits." Nine other supplementary projects have been tentatively drafted, such as "Changes in Capital Requirements of Business Enterprise and the Decline of the Commercial Loan"; "Major Factors in Fluctuations in Bank Deposits, 1929–1936"; "Financing the Consumer and its Relations to Commercial Banking"; "Studies of Bank Earnings and Expenses." The scheme evidently contemplates a more detailed investigation even than that carried out by our Macmillan Committee, and will require a considerable expansion of the present statistical apparatus of finance in the States. This little book will amply repay perusal.

We have to congratulate two Fellows, W. Palin Elderton, C.B.E., and D. R. Wilson, Senior Inspector of Factories, on the honour of knighthood which was conferred on them in the New Year's List, and Dr. E. C. Snow on being made a Commander of the Order of the British Empire. Sir William Palin Elderton is now a member of the Council, and Sir Duncan Wilson was formerly a member. Dr. Snow has been an Honorary Secretary of the Society since 1930. All Fellows will regard these well-merited honours as, in part, a tribute to the work of the Society.

It is also with pleasure that we learn that our Honorary Fellow, R. H. Coats, of the Dominion Bureau of Statistics, has been elected President of the American Statistical Society. The fact that he is the first Canadian to occupy this post adds to our pleasure, for the Society recognized his ability by making him an Honorary Fellow as long ago as 1924.

Our Fellow, H. Leak, Assistant Secretary, Statistical Department, Board of Trade, and at present serving on the Society's Council, has been elected a member of the International Statistical Institute.

Fellows will have noted with pleasure the appointment of our colleague, Professor T. E. Gregory, as Economic Adviser to the Central Government of India for a period of five years from 1938. We offer him our congratulations.

All Fellows will learn with regret that Mr. John A. P. Mackenzie retired on pension as from December 31st, 1937. He entered the service of the Society in 1881, and for the last forty-five years was Librarian. The feelings of the Council at his departure are expressed in the following extract from a letter which they addressed to him :—

> "Your separation from [the Council's] work means the breaking of another link with a past which is charged with many pleasant recollections. The Society is indebted to you for a long period of loyal service as Librarian in which your devotion to duty has been beyond praise and your intimate knowledge of their library has been of inestimable advantage to a great number of students and investigators. You will need no assurance that you will carry with you into retirement the esteem and gratitude not only of the Council, but also of all those who at any time have availed themselves of your help. In bidding you an official farewell, the President and Council express the hope that you will enjoy many happy years of leisure."

We are asked to publish the following announcement with respect to the Leverhulme Research Fellowships, 1938 :—

Application is invited for (i) Fellowships or (ii) Grants in aid of research. The Fellowships or Grants are intended for senior workers who are prevented from carrying out research work by routine duties or pressure of other work. They are limited to British-born subjects normally resident in Great Britain. In exceptional circumstances the Trustees may waive the condition as to residence.

The duration of the awards will not normally extend over more than two years or less than three months and the amount will depend on the nature of the research and the circumstances of the applicant. Any subjects which may add to human knowledge may be proposed for a Fellowship or Grant, but preference is given to subjects in which other provision for research is inadequate.

Forms of application may be obtained from the Secretary, Dr. L. Haden Guest, Leverhulme Research Fellowships, Union House, St. Martins-le-Grand, London, E.C. 1.

Applications must be received on or before March 1st, 1938. Awards will be announced in July and the Fellowships or Grants will date from September 1st, 1938.

OBITUARY

WILLIAM SEALY GOSSET, 1876–1937

BOTH the practice and science of agriculture owe much to the efforts of men whose normal avocations are other than those of farming. Among these must be included William Sealy Gosset, whose passing the members of this Society, in common with many others, mourn to-day.

Born on the 13th June, 1876, Gosset was the eldest son of Colonel Frederic Gosset, late R.E., and of Agnes Sealy Gosset, both of whom survive him. He received his early schooling at Cullercoats and Gore Court, Sittingbourne, Kent, and later at Winchester. From there he proceeded to New College, Oxford, where he gained a 1st Class Mathematical Moderatorship in 1897, and a 1st Class in Natural Sciences in 1899.

From Oxford he joined the technical staff of Messrs. Arthur Guinness, Son & Co. in Dublin. In 1906 he married Marjory, the youngest daughter of the late James L. Phillpotts, Esq., for many years the Headmaster of Bedford Grammar School, who with one son and two daughters survive him.

The necessity produced the man in a very real sense in Gosset's case. The opening of the century witnessed an awakened interest in experimental agriculture and a more scientific approach to the improvement of crop plants. Amongst the many efforts proceeding from these influences was one instituted by the combined efforts of Messrs. Arthur Guinness, Son & Co. and the Irish Department of Agriculture to improve the Irish barley crop. The various schemes of experiment proceeded satisfactorily for a number of years, but gradually a position developed in which it became necessary to test smaller quantities of material than previously. In time the practical difficulties surrounding the cultivation of small plots of barley were surmounted, but the degree of reliability that could be attached to the results so obtained presented yet another and more serious difficulty.

I well remember the uneasiness with which I studied the figures of some of the earliest small-scale tests and the sense of relief when I was invited by a member of Messrs. Guinness' staff to submit my data to a " young member of the brewing staff named Gosset " for statistical examination. The letter I received in reply from Gosset, one of a long series which I still prize, was clear, concise, full of help and promise of future assistance—a key, as I learned in time, to a very sterling character.

In this way and from my data and those of other workers in the same field arose Gosset's appreciation of the practical and theoretical aspects of agricultural experimentation. His statistical treatment of samples derived from experiments which are inevitably limited in number has been amplified by later workers, but it is doubtful whether the position could have been advanced so rapidly had it not been for Gosset's ability to visualize practical limitations and issues. He displayed a readiness to work within limits prescribed by established conditions of varying nature, and thereby inspired confidence in those less familiar with the mathematical line of approach.

Then followed a series of papers with their authorship disguised under the *nom de plume* of " Student " and, arising out of them, requests for advice from all parts of the world. Thus, unheralded and unsought by himself, Gosset achieved an international reputation, and became the exponent of more scientific methods of agricultural experimentation.

Amongst his immediate colleagues at St. James's Brewery Gosset enjoyed an enviable reputation for the soundness of his views and clarity of exposition, and such was the confidence he inspired that no one was surprised when he was deputed to take control of Messrs. Guinness' new undertaking at Park Royal.

Gosset was the personification of modesty, courteous in manner to all, quiet in address, neither using dialectical arts himself nor being deceived by them in others. In argument he experienced no pleasure, although when necessary he would maintain his position with a delightfully disarming and very characteristic persuasiveness.

Those who were privileged to know Gosset in his home realized a pervading spirit of freedom and joyousness; there, discarding the weight of heavy responsibilities, he radiated that boyishness of spirit that made him at all times such a delightful but yet never flippant companion.

To his immediate friends Gosset leaves an example of loyalty and generosity in feeling and action, to a wider circle that of leadership in a subject he made peculiarly his own, but to all a sense of heavy loss.

H. H.

In the statistical world Gosset will be remembered above all for the notable contribution which he made to *Biometrika* in 1908. Concerned as he was with the problem of determining the significance of the mean of a sample from a normal population when the only knowledge regarding the standard deviation of the latter was the estimate derived from the sample, " Student " worked out the first four moments of the distribution of s^2, the sample estimate of what was later called the variance, and fitted the appropriate Pearsonian curve. This turned out, in fact, to be the exact solution of the problem. Proceeding to determine the random sampling distribution of $z = \bar{x}/s$, "Student" gave the test which is now imperishably associated with his name, and provided a short table for calculating the probability associated with a given value of z, later expanded and modified in "Metron" as the table of the t-distribution. The work of 1908 was the forerunner of the modern exact tests appropriate to small samples, which have proved to be of such inestimable value, particularly to the biologist.

This was far from being "Student's" only contribution to the theory of statistics, but it was a very notable single achievement. In particular his illustrations of what later became known as his method of paired differences provided an admirable example of the principle of reduction of error by the control of experimental design, and foreshadowed the extension of this principle to the now well-known experimental methods which were developed specifically in the realm of agricultural experimentation. One of the pioneer papers on the subject of the experimental error of field trials was that of Mercer and Hall in the *Journal of Agricultural Science* for 1911. To this paper "Student" contributed an appendix describing his method of utilizing a given area of land to the best advantage in testing two varieties. This method was used by E. S. Beaven in devising his well-known half-drill strip system for variety tests on cereals, described in an article in the *Journal of the Ministry of Agriculture* in 1922. "Student" himself contributed to *Biometrika* (Vol. 15) a paper dealing with Beaven's "chess-board" and half-drill strip methods, and more recently provided an admirable article on "Yield Trials" for the 1931 edition of Baillière's *Encyclopædia of Scientific Agriculture.*

Gosset became a Fellow of this Society in 1933, being one of the first to welcome with enthusiasm the creation of the Industrial and Agricultural Research Section, and he came to London specially to attend the inaugural meeting of the Section on November 23rd, 1933. On taking up his new duties in London he became a regular attender at the Section meetings, and on March 26th, 1936, he shed his anonymity and opened in person a discussion on "Co-operation in Large-Scale Experiments," which ranged over the whole field of his own contributions to the subject, and led to a most interesting and valuable series of communications from subsequent speakers.

J. W.

An old friend (E. M. E.) writes :—

"Alas, I cannot put my hand on one or two letters I know I kept—one about his hat, the only one he ever possessed, I believe. He came into my room at University College flourishing a hat, and explained that he had bought it to go to a Board meeting in town—under family pressure, I suspect. He wrote soon after, and confessed that he had left it in the train, and that his son would have to retrieve it from the Lost Property Office.

"Did you ever hear Gosset say an unkind thing about anyone? He had an excuse for all the failings of other people, and how he enjoyed life—wet or fine—in bad days and good! It is indeed a tragedy that he should be deprived of life at 61, and his friends of one who made for peace and happiness.

"When I begin to think of Gosset, I don't think I saw anything much of him till after the war, when he used to come to the Lab. on his yearly holidays for a passing visit and later as an examiner; then he generally came straight to my room, dumped his rucksack in my arm-chair, and asked whether 'himself' was free; he would have tea in the common room, but seldom talked work. At one time he was great on crossing loganberries and blackberries (I think this was the combination), and he got something he called a jam-berry, and told us how to make jam of his berry (you must not boil it), and brought up a pot which we added to our bread and butter at tea-time. Generally he and I had a short chat, and others used to claim his company at tea.

"I doubt whether I knew him very well, but our attitude was similar, and we saw things from the same point of view, but we did not correspond except once or twice about work. He came here with one of his daughters a year ago last month, and we talked of old times and present difficulties, and I was struck as I always was by his enjoyment of what I should call the simple pleasures of life."

PROFESSOR GEORGE WILLIAM DANIELS

IT is hard to believe that Professor Daniels is dead. He died from heart trouble on December 17th, 1937—a few weeks before his sixtieth birthday. He had been for so long an essential part of the academic and business life of Manchester—belonging to Manchester and to nowhere else—that it is difficult to think of Manchester without him. It is sad to reflect that he will never again be seen wearing what always seemed to us the same light grey suit, the same heavy brown shoes and, in winter, the same macintosh, walking across the quadrangle regularly at nine o'clock each morning. Collecting his letters from his box in the porter's office, he used to climb the steps and make his way along the corridor to his room in the farthest corner of the main building of Owens College overlooking Burlington Street. There was his sanctum—a square room with a rolled-top desk with a portrait of Marshall hanging above, untidy piles of *Punch* sharing the window-ledge with a telephone ("I'll have that telephone out ! "), a small blackboard on which on a famous occasion Jewkes and I tried to explain the necessity of weighting index numbers, and a gas fire round which he used to advise, persuade, and occasionally reminisce to us about his early life and struggles.

He was a man of the widest interests. Essentially practical in outlook and with a natural flair for administration, he had been trained in the method of economics by Chapman, and had shared enthusiasm for economic history with Unwin. He was the ideal head of a department. We could all go to him for advice on problems, whether personal or related to our research work. He stimulated in his staff much of his own intense loyalty for Manchester and its traditions. His was a dominating personality. Those who knew him best admired him the most.

His interest in statistical enquiries developed in his later life. Most of his published statistical work appeared in the *Transactions of the Manchester Statistical Society*, and he contributed only one paper to the *Journal* (" The Post-War Depression in the Lancashire Cotton Industry ") with Jewkes in 1928. He did not become a Fellow of the Society until 1930. In that year he was chosen President of the Manchester Society, and by virtue of that position became an honorary Fellow of the Royal Statistical Society, but he preferred to be elected an ordinary Fellow. Already when he read his paper in 1928 he was stricken with the disease which was in the end to prove fatal, and during succeeding years most of his time was devoted to University Administration and to the direction of economic research work in the Department. (No one owes more to him than I for his encouragement and collaboration in those years.) So far as I know, he did not attend any meeting of the Society after his election. I tried to persuade him to attend the Centenary meeting of Jevons. He once told me that it was Jevons' *Primer of Political Economy* which attracted him to economics and persuaded him to leave industry to seek an academic career. Nothing gave him more satisfaction in the last years of his life than to reflect he was the Stanley Jevons Professor of Political Economy in the University. He did not attend the meeting, for he was already a very sick man. The end, when it came, was as unexpected as it was expected. H. C.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

UNITED KINGDOM—

Annals of Eugenics, October, 1937—Tests of significance for samples of the χ^2 population with two degrees of freedom: *P. V. Sukhatme.* Significance of grouping: *W. L. Stevens.* Inheritance in man: Boas's data studied by the method of analysis of variance: *R. A. Fisher.*

The Banker—

November, 1937—The future of London as an international lender: *W. W. Syrett.*

December, 1937—Repayment of French sterling credit: *P. Einzig.*

Bankers' Magazine—

October, 1937—Credit, confidence, and government control. Banking in Australia (Report of Royal Commission).

November, 1937—France and the franc: *F. J. Scanlan.* Beet sugar and the banker: *F. A. Willman.*

East India Association, Journal, October, 1937—The population problem in India: *Prof. R. Mukerjee.*

Economic Journal, September, 1937—Real and money wage rates in relation to unemployment: *Prof. A. C. Pigou.* Alternative theories of the rate of interest: three rejoinders: *Prof. B. Ohlin, D. H. Robertson,* and *R. G. Hawtrey.* A theory of commodity, income, and capital taxation: *M. Kalecki.* Railway passenger receipts and fares policy: *E. J. Broster.* The London building industry and its labour recruitment through employment exchanges: *R. G. D. Allen* and *B. Thomas.* The changing organisation of arable farms: *R. McG. Carslaw* and *P. E. Graves.* Post-war public companies: a study in investment and enterprise: *P. W. S. Andrews.*

Economica, November, 1937—Technical improvements, unemployment and reduction of working hours: *A. G. B. Fisher.* Some aspects of discrimination by public utilities: *C. L. Paine.* Parenthood and poverty: *H. S. Booker.*

Eugenics Review, October, 1937—Intelligence, fertility and socio-economic factors: *R. B. Cattell.* Eugenic problems needing research: *C. P. Blacker.* The measurement of social competence: *E. A. Doll.*

Faculty of Actuaries, Transactions, Part V, 1937—New methods of approximate valuation: *S. R. Hellig.*

Financial Review of Reviews, September, 1937—Booms and slumps: some facts and points: *E. T. Good.*

Geographical Journal, October, 1937—Factors in the development of the Cotswold woollen industry: *R. P. Beckinsale.*

UNITED KINGDOM—*Contd.*

Health and Empire, September, 1937—Nutrition in relation to education, agriculture, and medicine: *Sir J. B. Orr.* Some problems of recruited labour: *Major G. St. J. Orde Browne.*

Institute of Actuaries, Journal, Part III, 1937—The estimated population of Great Britain, 1941–1971: *F. J. C. Honey.*

Institute of Bankers, Journal—

November, 1937—The German credit and banking system under the influence of the new banking law: *Prof. Dr. Wilhelm Kalveram.*

January, 1938—Problems of international finance: *V. Kienböck.*

Lloyds Bank Ltd. Monthly Review—

November, 1937—Recovery and the distressed areas: *D. Tyerman.*

December, 1937—Germany: why and how? *P. Osthold.*

Manchester Statistical Society, Transactions, Session 1936-37—Applications of the sampling technique to crop estimation and forecasting: *F. Yates.* Some uses of statistics in colonial administration: *G. L. M. Clauson.* Treasury control and cheap money: *Prof. N. F. Hall.* Recent changes in the organisation of the Japanese cotton industry: *G. C. Allen.* The location of industry: *S. R. Dennison.* Changes in British import trade, 1924–36: *G. N. Butterworth* and *H. Campion.* The home market for textiles in Great Britain: *C. T. Saunders, A. C. Wild, E. Devons.*

Midland Bank Monthly Review, September–October, 1937—The British Railways 1931–37.

Population, December, 1937—Population phenomena in Amsterdam: *J. H. van Zanten* and *T. van den Brink.* Population movement of Hungary: *J. de Konkoly Thege.* Trend of birth-rate of Oriental population of United States: *S. J. Holmes.* Die Auswanderung der Deutschen Juden seit 1933: *K. Zielenziger.*

Public Administration, October, 1937—The co-ordination of means tests: *P. Ford.*

Review of Economic Studies, October, 1937—Measuring the power of undervalued currency to stimulate exports: *V. Edelberg* and *A. Krishnaswami.* Economics and insurance: *L. T. Little.* Numerical computation of the elasticity of substitution: *A. L. Bowley.* A note on gold movements in the present international monetary system: *F. Lutz.*

Royal Sanitary Institute, Journal, December, 1937—Discussion on "incapacitating sickness." First paper by *P. L. McKinlay.*

Royal Society of Arts, Journal, November 19, 1937—The Empire dried fruits industry: *A. E. Gough.*

Royal Society of Edinburgh, Proceedings, Vol. LVII, Part III—Tests for randomness in a series of numerical observations: *W. O. Kermack* and *Lt.-Col. A. G. McKendrick.*

Westminster Bank Review, December, 1937—Anglo-American trade.

INDIA—

Indian Journal of Economics, October, 1937—Age composition and sex ratio of the population in the British Districts of the Bombay Presidency: *G. Raghava Rao.* The problem of correlation between exchange rates and exports: *B. K. Sarkar.* Imports of gold in India before 1931: *N. S. Pardasani.* A critical survey of railway finances in India since 1924: *L. C. Tandon.*

Sankhyā, Indian Journal of Statistics, September, 1937—On the moment-coefficients of the D^2-statistic and certain integral and differential equations connected with the multivariate normal population: *S. N. Bose.* The ratio question: *H. Sinha* and *J. C. Sinha.* Inaccuracies in the Bengal census report, 1931: *J. M. Dutt.*

UNION OF SOUTH AFRICA—

South African Journal of Economics, September, 1937—Gold, 1936–1937: *Prof. R. Leslie.* Exchange depreciation and the future of gold: *J. N. Reedman.* The comparative sociology of South Africa: *Prof. J. L. Gray.*

UNITED STATES—

American Academy of Political and Social Science, Annals, September, 1937—Revival of depressed industries: describing the status of selected industries, with special reference to efforts toward recovery and expansion. (Whole number.)

American Economic Review, December, 1937—Capacity to produce, consume, pay debts: *J. R. Commons.* Capital supply and national well-being: *D. D. Humphrey.* Survey of work-relief wage policies: *A. E. Burns* and *P. Kerr.* Incidence and effects of taxation: *M. Slade Kendrick.* What is money? *R. H. Lounsbury.*

American Statistical Association, Journal—

September, 1937—The counting of farms in the United States: *J. D. Black* and *R. H. Allen.* Variations among cities in per capita income: *E. L. Thorndike.* Outline of 1936 mortality and natality tabulations: *F. E. Linder.* On an attempt to reduce infant mortality in Denmark: *H. Cl. Nybolle.* Statistical problems in the administration of social security: *E. Clague.* Regressions and their standard errors in subsets of variables: *J. L. Mosak.* Correlation between means and standard deviations: *F. R. Immer.*

December, 1937—Comparability versus change: *V. D. Reed.* The whole duty of the statistical forecaster: *R. W. Burgess.* The preparation of correlation tables on a tabulator with digit selection: *P. S. Dwyer* and *A. D. Meacham.* Revised method of calculation of the B.L.S. wholesale price index: *J. M. Cutts* and *S. J. Dennis.* The use of ranks to avoid the assumption of normality: *M. Friedman.* Some adjustments in census data on unemployment: *D. D. Humphrey.*

UNITED STATES—*Contd.*

Econometrica, October, 1937—The nature of regression functions in the correlation analysis of time series: *H. E. Jones*. Note on the phase diagram of two variates: *R. Frisch*. An example of meaningful curvilinear regressions in economic time series: *H. Mendershausen*. Economic consequences of technical development, with some illustrations from Danish industries: *L. R. Nienstaedt*.

Monthly Labor Review, November, 1937—Labor in depression and recovery, 1929 to 1937.

Quarterly Journal of Economics, November, 1937—Import quotas in the United States: *C. R. Whittlesey*. The short-cut graphic method: an illustration of "flexible" multiple correlation techniques: *W. Malenbaum* and *J. D. Black*. The substitution of scrap for pig-iron in the manufacture of steel: *R. F. Fowler*.

Review of Economic Statistics, November, 1937—The theory of index-number bias: *Edwin Frickey*. An annual estimate of savings by individuals: *Mordecai Ezekiel*. Export, import, and domestic prices in the United States, 1931 36: *P. T. Ellsworth*.

Social Research, November, 1937—Investment fluctuations as cause of the business cycle: *Hans Neisser*. Reflections on the social structure in China: *K. Bloch*.

Wheat Studies of the Food Research Institute, November, 1937—Trends of yield in major wheat regions since 1885. Part I, General considerations and rising trends: *M. K. Bennett*.

BELGIUM—

Revue du Travail, Décembre, 1937—Monopole corporatif et concurrence à l'épreuve de l'expérience historique: *L. Deschesne*.

DENMARK—

Nationaløkonomisk Tidsskrift, Hefte 5, 1937—International capital movements: *B. Ohlin*. Forbruget i københavnske Familier i 1916, 1922 og 1931: *Povl Heiberg*. Hvorledes gaar det med det russiske Landbrug? *Aage Fjellerup*.

FRANCE—

Journal des Économistes, Juillet–Octobre, 1937—Le redressement du commerce mondial: *E. Hantos*. Le Nouveau Régime des chemins de fer: *E. Rouland*. Les mésaventures du franc: *F. Gaucherand*.

Journal de la Société de Statistique de Paris

Novembre, 1937—Chronique de démographie: *H. Bunle*.

Décembre, 1937—Production et possibilité de production: *B. Nogaro*.

GERMANY—

Allgemeines Statistisches Archiv, Heft 2, 1937—Die Motorisierung in der Statistik: *W. Grävell.* Die praktische Statistik im Dienste der Raumordnung: *J. Griesmeier.* Fortbildung der deutschen Bevölkerungsstatistik durch erbbiologische Bestandsaufnahmen: *F. Zahn.* Statistik obligatorisches Prüfungsfach für Diplomvolkswirte: *F. Zahn.*

Archiv für Mathematische Wirtschafts- und Sozialforschung, Heft 3, 1937—Die Messung der Ungleichheit zweier Verteilungen. angewendet auf die Untersuchung von qualitativen Rassenmerkmalen: *C. Gini.* Über die Wahrscheinlichkeit, dass zwei Stichproben von einander mehr als zwei gegebene Verteilungen abweichen (Anhang I zu C. Gini's Aufsatz.): *V. Castellano.* Ausdehnung der Dreieckskoordinatendarstellung auf Hyperraüme (Anhang II zu C. Gini's Aufsatz.): *V. Castellano.* Altersaufbau und Wachstum der Bevölkerung: *S. Vianelli.*

Deutsches Statistisches Zentralblatt, Hefte 5–6, 1937—Zur gegenwärtigen Lage der deutschen Fremdenverkehrsstatistik: *R. Ehrhardt.*

Vierteljahrshefte zur Wirtschaftsforschung, Heft 2, 1937-38—Moderne Methoden der Kreditpolitik: *E. Wagemann.* Gibt es eine Gesetzmässigkeit in den Schwankungen der Austauschrelationen zwischen Industrie -und Rohstoffländern: *O. Emminger* and *E. Wolf.* Die Ernährung in England und Deutschland: *H. von der Decken.*

Weltwirtschaftliches Archiv, November, 1937—Das Goldproblem: *D. T. Jack.* Zur Theorie des Beschäftigungsgrades: *C. Föhl.* Einfuhrzoll oder Ausfuhrzoll als Mittel zur Steigerung des volkswirtschaftlichen Ertrages? *A. Kruse.*

HUNGARY—

Journal de la Société Hongroise de Statistique, N. 3, 1937—La statistique et l'ordre mystérieux de la vie: *Z. Bencs.*

ITALY—

Economia, Ottobre–Novembre, 1937—Caratteristiche geografiche dei fatti demografici e condizioni per renderne possibili l'isolamento e lo studio: *U. Giusti.*

Giornale degli Economisti e Rivista di Statistica, Novembre, 1937—I movimenti internazionali dell' oro nel decennio 1927–36: *G. Mortara.*

SWEDEN—

Ekonomisk Tidskrift, Häft 4–5, 1937—Socialekonomisk analys: *J. Åkerman.*

INTERNATIONAL—

International Labour Review, November, 1937—Keynes' "General Theory": a rejoinder to Professor Cassel: *A. P. Lerner.* The definition of accidents in the Swiss compulsory accident insurance scheme: *E. Haymann.*

International Review of Agriculture, November, 1937—Present tendencies on the world cotton market: *M. Tcherkinsky.*

Revue de l'Institut International de Statistique, Livr. 3, 1937—Une question importante pour la science des constitutions et pour la médecine militaire: comment juger si les proportions d'un individu sont normales? deuxième note (avec résumé anglais): *C. Gini.* Familienstatistik und Fruchtbarkeitsmessung. Neue Aufgaben und neue Wege der deutschen Bevölkerungsstatistik (avec résumé français et anglais): *F. Burgdörfer.* Quelques observations sur les rapports entre le mouvement de la nuptialité et la décroissance de la natalité: *E. Wurzburger.*

LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part IV, 1937, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS

(a) **United Kingdom**

Agriculture and Fisheries, Ministry of—

- Report of the Sugar Commission. . . . 31 March 1937. 32 pp. 6*d*.
- Report of operations and proceedings under the Land Drainage Act, 1930 . . . to 31 March 1937. 75 pp. 1*s*. 6*d*.

[London : H.M.S.O., 1937. 9¾″ × 6″.]

Colonial Office—

- Customs tariffs of the colonial empire. Part II.—Eastern, Mediterranean, and Pacific. . . . 260 pp. 3*s*. 6*d*.
- Higher education in East Africa : report of the Commission appointed by the Secretary of State for the Colonies. 136 pp. 2*s*. 6*d*.
- Information as to the conditions and cost of living in the colonial empire. 3rd. ed. 223 pp. 3*s*. 6*d*.
- Palestine Royal Commission report. 404 pp. 6*s*. 6*d*. Cmd. 5479.

[London : H.M.S.O., 1937. 9¾″ × 6″.]

Commerce, Ministry of, for Northern Ireland. Census of production, 1935. Belfast : H.M.S.O., 1937. 9¾″ × 6″. 207 pp. 2*s*. 6*d*.

Education, Board of. Teachers' (Superannuation) Act, 1937. Allocation of pension, explanatory memorandum. Teachers' superannuation (allocation of pension) rules, 1937. Papers prepared by the Government Actuary. London : H.M.S.O., 1937. 9¾″ × 6″. 27 pp. 6*d*.

Forestry Commission. Bulletin no. 14 (revised 1937). Forestry practice. London : H.M.S.O., 1937. 9¾″ × 6″. 99 pp. 1*s*. 6*d*.

General Register Office. Census of England and Wales, 1931. County of Durham (Part II). London : H.M.S.O., 1937. 13¼″ × 8″. 26 pp. 1*s*. 3*d*.

Geological Survey and Museum. The first hundred years of the Geological Survey of Great Britain. By *Sir John Smith Flett*. London : H.M.S.O., 1937. 9¾″ × 6″. 280 pp. 7*s*. 6*d*.

Health, Department of, for Scotland. Summary of report of Committee on Scottish health services. Edinburgh : H.M.S.O., 1937. 30 pp. 6*d*.

Health, Ministry of—

- Construction of flats for the working classes. Final report of the Departmental Committee. 55 pp. 1*s*.
- Rents of houses and flats owned by local authorities (England and Wales). 24 pp. 4*d*.

[London : H.M.S.O., 1937. 9¾″ × 6″.]

Imperial Economic Committee—

- Supplies of canned and dried fruit 1936. . . . 13″ × 8¼″. 86 pp.
- Summaries of figures of production and trade relating to :—
  - Dairy Produce: Butter, cheese, preserved milk, casein, eggs, egg products. 79 pp.
  - Fruit: Apples, pears, bananas, citrus fruit, grapes, wine, raisins and currants, canned fruit. 83 pp.
  - Industrial Fibres: Cotton, wool, silk, flax, jute, hemp and rayon. 127 pp.
  - Meat: Beef, cattle, mutton and lamb, sheep, bacon and hams, pigs, pork, canned meat. 94 pp.

[London : H.M.S.O., 1937. 9¾″ × 7¼″. 2*s*. 6*d*. each.]

Industrial Health Research Board. Report no. 80. Toxicity of industrial organic solvents : summaries of published work compiled by *Ethel Browning* under the direction of the Committee on the Toxicity of Industrial Solvents. London : H.M.S.O., 1937. 9¾″ × 6″. 396 pp.

(a) **United Kingdom**—*Contd.*

Labour, Ministry of—

Industrial Courts Act, 1919. Report . . . concerning disputes between plasterers and joiners in Scotland. 13 pp. 3*d.*

Report of the Commissioner for the Special Areas in England and Wales . . . 1937. 209 pp. 3*s.* 6*d.*

Summary of the Unemployment Insurance Acts 1935 and 1936. 32 pp. 6*d.*
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New Zealand—

Census and Statistics Department. Population census 1936. Vol. I. Increase and location of population. xii + 67 pp. 4*s.* 6*d.* Vol. II. Dependencies . . . 11 pp. 1*s.* 6*d.* Appendix A. Census of poultry. vi + 14 pp. 1*s.* 6*d.* Wellington, 1937. 12½″ × 10″. 3 parts.

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REVENUE OF THE UNITED KINGDOM

Net Produce in Quarters of 1937, *and in Financial Years ended March* 31, 1936-37, 1935-36, 1934-35, 1933-34

(000's omitted)

QUARTERS, end	March 31, 1937	June 30, 1937	Sept. 30, 1937	Dec. 31, 1937	Total for calendar year 1937
	£	£	£	£	£
Customs	52,372	54,722	56,341	56,902	220,337
Excise	25,200	26,700	28,400	33,300	113,600
Stamps and Estate Duties	35,350	28,510	28,580	27,320	119,790
Other Inland Revenue Duties	580	90	60	380	1,110
Postal Service Telegraph Service Telephone Service	20,750	20,850	20,700	23,325	85,625
National Defence Contribution	—	—	—	59	59
	134,252	130,902	131,081	141,286	540,521
Property and Income Tax, including Super Tax	224,411	17,720	43,323	39,772	325,226
	358,663	148,622	177,401	181,058	865,717
Excess Profits Duties Corporation Profits Tax	1,000	—	—	—	1,000
Motor Vehicles Tax	21,391	4,683	3,926	2,998	32,998
Crown Lands	300	260	380	390	1,330
Interest on Sundry Loans	915	362	3,013	882	5,202
Miscellaneous and Special Receipts	9,302	1,306	4,765	1,033	19,406
	391,571	155,233	189,518	189,361	925,683

YEARS, end March 31,	1936-37	1935-36	1936-37 (compared with 1935-36)		Corresponding years	
			Increase	Decrease	1934-35	1933-34
	£	£	£	£	£	£
Customs	211,282	196,642	14,640	—	185,096	179,177
Excise	109,500	106,700	2,800	—	104,600	107,000
Stamps and Estate Duties	117,130	113,720	3,410	—	105,466	107,980
Land Tax and Mineral Rights Duty	730	785	—	55	770	800
Postal Service Telegraph Service Telephone Service	82,950	77,750	5,200	—	71,000	72,400
	521,592	495,597	26,050	55	469,932	467,357
Property and Income Tax, including Super Tax	310,777	289,094	21,683	—	280,012	281,522
	832,369	784,691	47,733	55	749,971	748,879
Excess Profits Duties Corporation Profits Tax	1,000	1,300	—	300	2,300	1,800
Motor Vehicle Duties	32,727	30,752	1,975	—	31,538	30,712
Crown Lands	1,350	1,360	—	10	1,320	1,230
Interest on Sundry Loans	4,550	4,934	—	384	4,372	4,655
Miscellaneous— Ordinary receipts Special receipts	24,600	21,738	2,862	—	15,125	22,103
Total	896,596	844,775	52,570	749	804,629	809,379
			NET INCR. £51,821			

Values (c.i.f.) of Imports* *into the United Kingdom for the years* 1935-36-37

(From the Monthly Trade Returns, December, 1937)

	Year ended December 31,			Increase or Decrease, 1937—1936	Increase or Decrease, 1937—1935
	1935	1936	1937		
I. FOOD, DRINK AND TOBACCO—	£	£	£	£	£
A. Grain and flour	56,731,969	69,536,113	91,411,142	+ 21,875,029	+ 34,679,173
B. Feeding-stuffs for animals	7,712,089	8,458,376	11,364,416	+ 2,906,070	+ 3,652,357
C. Animals, living, for food	5,569,506	7,232,528	7,122,327	– 110,201	+ 1,552,821
D. Meat	77,759,114	78,770,957	87,140,445	+ 8,369,488	+ 9,381,331
E. Dairy produce	58,419,229	67,303,102	72,987,681	+ 5,681,579	+ 14,568,452
F. Fresh fruit and vegetables	39,123,530	36,319,358	37,326,193	+ 1,006,835	– 1,797,337
G. Beverages and cocoa preparations	42,923,825	44,671,680	48,510,258	+ 3,838,578	+ 5,586,433
H. Other food	49,307,400	50,785,698	58,415,176	+ 7,629,478	+ 9,107,776
I. Tobacco	17,576,527	18,489,265	18,095,508	– 393,757	+ 518,981
Total, Class I	355,123,189	381,567,077	432,373,176	+ 50,806,099	+ 77,249,987
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED—					
A. Coal	20,230	32,119	23,790	– 8,329	+ 3,560
B. Other non-metalliferous mining and quarry products and the like	3,727,912	4,304,259	5,317,108	– 1,012,849	+ 1,589,196
C. Iron ore and scrap	5,041,631	8,358,074	12,612,078	+ 4,254,004	+ 7,570,447
D. Non-ferrous metalliferous ores and scrap	11,648,688	12,276,146	19,002,309	+ 6,726,163	+ 7,353,621
E. Wood and timber	35,516,257	43,516,879	61,823,873	+ 18,306,994	+ 26,307,616
F. Raw cotton and cotton waste	37,330,857	45,761,473	48,746,243	+ 2,984,770	+ 11,415,386
G. Wool, raw and waste, and woollen rags	36,755,272	45,655,949	52,188,984	+ 6,533,035	+ 15,433,712
H. Silk, raw, knubs and noils	1,509,741	1,824,644	2,263,802	+ 439,158	+ 754,061
I. Other textile materials	9,809,681	11,237,326	12,527,364	+ 1,290,038	+ 2,717,683
J. Seeds and nuts for oil, oils, fats, resins and gums	25,771,771	28,682,562	35,253,296	+ 6,570,734	+ 9,481,525
K. Hides and skins, undressed	14,657,427	19,507,765	25,188,055	+ 5,680,290	+ 10,530,628
L. Paper-making materials	10,757,385	11,889,531	15,971,311	+ 4,081,780	+ 5,213,926
M. Rubber	10,142,479	4,392,188	12,271,385	+ 7,879,197	+ 2,128,906
N. Miscellaneous raw materials and articles mainly unmanufactured	9,591,996	10,501,760	12,154,957	+ 1,653,197	+ 2,562,961
Total, Class II	212,281,327	247,940,675	315,344,555	+ 67,403,880	+103,063,228
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—					
A. Coke and manufactured fuel	45,323	130,144	82,237	– 47,907	+ 36,914
B. Pottery, glass, abrasives, &c.	7,356,877	7,488,716	8,171,559	+ 685,843	+ 817,682
C. Iron and steel and manufactures thereof	8,714,815	11,740,594	19,835,096	+ 8,094,502	+ 11,120,251
D. Non-ferrous metals and manufactures thereof	28,000,118	33,153,245	55,731,368	+ 22,578,123	+ 27,731,250
E. Cutlery, hardware, implements and instruments	6,202,585	6,858,662	7,719,756	+ 891,094	+ 1,517,171
F. Electrical goods and apparatus	3,089,485	3,662,140	4,083,247	+ 421,107	+ 993,762
G. Machinery	13,225,144	17,973,634	24,223,737	+ 6,250,103	+ 10,998,593
H. Manufactures of wood and timber	6,172,894	7,457,178	8,390,230	+ 933,052	+ 2,217,336
I. Cotton yarns and manufactures	2,382,163	2,833,705	3,428,321	+ 594,619	+ 1,046,161
J. Woollen and worsted yarns and manufactures	2,474,462	3,135,706	4,234,243	+ 1,098,537	+ 1,759,781
K. Silk yarns and manufactures	3,027,519	2,562,396	2,604,208	+ 41,812	– 423,311
L. Manufactures of other textile materials	6,773,230	7,445,713	8,093,690	+ 647,977	+ 1,320,460
M. Apparel	8,493,852	9,553,668	10,880,714	+ 1,327,046	+ 2,386,862
N. Chemicals, drugs, dyes and colours	11,601,484	12,579,464	13,837,325	+ 1,257,861	+ 2,235,841
O. Oils, fats and resins, manufactured	32,618,059	36,124,899	46,614,053	+ 10,489,154	+ 13,995,994

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* The value of the Imports represents the cost, insurance and freight; or, when goods are consigned for sale, the latest sale value of such goods.

Values (c.i.f.) of **Imports** *for the years* **1935-36-37**—*Contd.*

(From the Monthly Trade Returns, December, 1937)

	Year ended December 31, 1935	1936	1937	Increase or Decrease, 1937—1936	Increase or Decrease, 1937—1935
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—*Contd.*	£	£	£	£	£
P. Leather and manufactures thereof	8,112,835	9,721,529	9,797,621	+ 76,092	+ 1,684,786
Q. Paper, cardboard, &c.	13,447,301	14,488,491	17,202,039	+ 2,713,548	+ 3,754,738
R. Vehicles (including locomotives, ships and aircraft...	4,532,917	5,107,841	6,461,726	+ 1,356,882	+ 1,931,809
S. Rubber manufactures	564,008	574,297	739,834	+ 165,537	+ 175,826
T. Miscellaneous articles wholly or mainly manufactured	17,683,391	20,086,130	22,818,217	+ 2,732,117	+ 5,134,856
Total, Class III	184,518,492	212,678,155	271,985,254	+ 62,307,099	+ 90,166,762
IV. ANIMALS, NOT FOR FOOD	1,662,062	1,913,626	3,031,017	+ 1,117,421	+ 1,368,985
V. PARCEL POST	2,155,467	3,652,333	3,330,591	− 321,739	+ 875,127
Total	756,040,537	817,751,866	1,029,061,626	+181,312,760	+ 273,021,089

Values (f.o.b.) of **Exports** *of Produce and Manufactures of the United Kingdom for the years* **1935-36-37**

(From the Monthly Trade Returns, December, 1937)

	Year ended December 31, 1935	1936	1937	Increase or Decrease, 1937—1936	Increase or Decrease, 1937—1935
I. FOOD, DRINK AND TOBACCO—	£	£	£	£	£
A. Grain and flour	1,831,755	1,810,213	1,733,126	− 77,087	− 98,629
B. Feeding-stuffs for animals	573,238	577,922	637,053	+ 59,131	+ 63,815
C. Animals, living, for food	6,235	3,269	95,862	+ 92,593	+ 89,627
D. Meat	922,303	1,060,158	1,151,383	+ 91,225	+ 229,080
E. Dairy produce	1,075,336	1,303,532	1,158,794	− 111,738	+ 83,458
F. Fresh fruit and vegetables	307,689	388,694	531,697	+ 143,003	+ 224,008
G. Beverages and cocoa preparations	9,765,988	13,528,470	15,524,103	+ 1,995,633	+ 5,758,115
H. Other food	12,881,865	12,408,508	12,909,668	+ 501,160	+ 27,803
I. Tobacco	4,214,761	4,501,696	5,038,385	+ 533,689	+ 823,624
Total, Class I	31,579,170	35,585,462	38,780,071	+ 3,191,609	+ 7,200,901
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED—					
A. Coal	31,558,678	29,299,239	37,666,791	+ 8,367,555	+ 6,108,116
B. Other non-metalliferous mining and quarry products and the like	1,099,622	1,127,877	1,353,155	+ 225,278	+ 253,533
C. Iron ore and scrap	152,980	391,193	881,333	+ 493,110	+ 131,353
D. Non-ferrous metalliferous ores and scrap	1,765,548	2,115,027	3,224,371	+ 1,109,344	+ 1,158,823
E. Wood and timber	83,606	88,325	98,035	+ 9,710	+ 14,429
F. Raw cotton and cotton waste	1,116,285	853,029	963,124	+ 110,095	− 153,161
G. Wool, raw and waste, and woollen rags	8,170,592	7,868,410	9,069,976	+ 1,201,566	+ 899,384
H. Silk, raw, knubs and noils	13,461	13,883	9,834	− 4,049	− 3,627
I. Other textile materials	400,493	504,352	580,880	+ 76,528	+ 180,387
J. Seeds and nuts for oil, oils, fats, resins and gums	3,200,070	3,195,188	3,759,063	+ 563,875	+ 558,993
K. Hides and skins, undressed	1,107,204	1,750,501	1,797,482	+ 46,981	+ 690,278
L. Paper-making materials	1,095,179	1,248,864	1,870,631	+ 621,767	+ 775,452
M. Rubber	163,833	194,537	391,300	+ 196,763	+ 227,467
N. Miscellaneous raw materials and articles mainly unmanufactured	2,608,360	2,656,282	2,983,154	+ 326,872	+ 374,794
Total, Class II	52,835,911	51,306,707	64,652,132	+ 13,345,425	+ 11,816,221

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* The value of the Exports represents the cost and the charges of delivering the goods on board the ship, and is known as the "free on board" value.

Values (f.o.b.) of **Exports** *for the years* **1935–36–37**—*Contd.*

(From the Monthly Trade Returns, December, 1937)

	Year ended December 31,			Increase or Decrease, 1937—1936	Increase or Decrease, 1937—1935
	1935	1936	1937		
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—	£	£	£	£	£
A. Coke and manufactured fuel...	3,019,143	2,992,322	4,235,717	+ 1,243,395	+ 1,216,574
B. Pottery, glass, abrasives, &c.	8,309,037	8,663,917	9,980,541	+ 1,316,624	+ 1,671,504
C. Iron and steel and manufactures thereof	35,958,498	35,966,688	48,404,198	+ 12,437,510	+ 12,445,700
D. Non-ferrous metals and manufactures thereof	14,076,230	12,142,134	15,740,593	+ 3,598,459	+ 1,664,363
E. Cutlery, hardware, implements and instruments	8,122,184	8,169,137	9,714,109	+ 1,544,972	+ 1,591,925
F. Electrical goods and apparatus	9,541,155	10,020,515	12,546,926	+ 2,526,411	+ 3,005,771
G. Machinery	39,352,247	41,179,280	49,776,062	+ 8,596,782	+ 10,423,815
H. Manufactures of wood and timber	1,062,328	1,218,285	1,322,118	+ 103,833	+ 259,790
I. Cotton yarns and manufactures......................	60,170,799	61,502,036	68,532,271	+ 7,030,235	+ 8,361,472
J. Woollen and worsted yarns and manufactures	30,366,794	32,213,547	35,486,432	+ 3,272,885	+ 5,119,638
K. Silk yarns and manufactures	1,142,389	1,264,368	1,490,818	+ 226,450	+ 348,429
L. Manufactures of other textile materials	15,732,296	17,295,396	20,326,538	+ 3,031,142	+ 4,594,242
M. Apparel............................	11,065,717	11,872,233	12,399,067	+ 526,834	+ 1,333,350
N. Chemicals, drugs, dyes and colours	21,328,503	21,091,994	24,660,151	+ 3,568,157	+ 3,331,648
O. Oils, fats and resins, manufactured	5,160,743	4,911,624	5,882,045	+ 970,421	+ 721,302
P. Leather and manufactures thereof	3,791,769	4,268,523	5,345,294	+ 1,076,771	+ 1,553,525
Q. Paper, cardboard, &c.	6,579,899	6,746,629	8,100,362	+ 1,353,733	+ 1,520,463
R. Vehicles (including locomotives, ships and aircraft)	29,485,832	32,250,889	39,934,214	+ 7,683,325	+ 10,448,382
S. Rubber manufactures............	1,512,141	1,569,136	1,654,021	+ 84,885	+ 141,880
T. Miscellaneous articles wholly or mainly manufactured	23,039,459	25,439,338	29,307,152	+ 3,867,814	+ 6,267,693
Total, Class III	328,817,163	340,777,991	404,838,629	+ 64,060,638	+ 76,021,466
IV. ANIMALS, NOT FOR FOOD	673,863	1,050,792	850,052	− 200,740	+ 176,189
V. PARCEL POST	11,928,321	11,883,927	12,473,502	+ 589,575	+ 545,181
Total..........................	425,834,428	440,604,879	521,594,386	+ 80,989,507	+ 95,759,958

Values (f.o.b.) of* **Exports of Imported Merchandise** *for the years* **1935–36–37**

(From the Monthly Trade Returns, December, 1937)

	Year ended December 31,			Increase or Decrease, 1937—1936	Increase or Decrease, 1937—1935
	1935	1936	1937		
I. FOOD, DRINK AND TOBACCO—	£	£	£	£	£
A. Grain and flour	780,250	799,979	1,877,787	+ 1,077,808	+ 1,097,537
B. Feeding-stuffs for animals......	59,748	38,050	49,732	+ 11,682	− 10,016
C. Animals, living, for food	—	—	—	—	—
D. Meat	813,274	634,575	623,362	− 11,213	− 189,912
E. Dairy produce......................	777,870	651,741	926,471	+ 271,730	+ 148,601
F. Fresh fruit and vegetables......	1,270,437	1,280,751	1,342,361	+ 61,610	+ 71,924
G. Beverages and cocoa preparations	6,449,028	6,198,981	6,558,837	+ 359,856	+ 109,809
H. Other food	1,545,119	1,180,558	1,313,716	+ 133,158	− 231,403
I. Tobacco	859,819	888,420	489,046	− 399,374	− 370,773
Total, Class I	12,555,545	11,676,055	13,181,312	+ 1,505,257	+ 625,767

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* The value of the Exports represents the cost and the charges of delivering the goods on board the ship, and is known as the "free on board" value.

Values (f.o.b.) of **Exports of Imported Merchandise** *for the years* **1935-36-37**—*Contd.*

(From the Monthly Trade Returns, December, 1937)

	Year ended December 31,			Increase or Decrease, 1937—1936	Increase or Decrease, 1937—1935
	1935	1936	1937		
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED—	£	£	£	£	£
A. Coal	—	—	3,099	+ 3,099	+ 3,099
B. Other non-metalliferous mining and quarry products and the like	217,812	252,003	369,218	+ 117,215	+ 151,406
C. Iron ore and scrap	1,562	612	815	+ 173	— 747
D. Non-ferrous metalliferous ores and scrap	412,682	294,592	726,806	+ 432,214	+ 314,124
E. Wood and timber	281,966	257,340	313,230	+ 55,890	+ 31,264
F. Raw cotton and cotton waste	2,360,995	1,952,128	2,039,958	+ 87,830	— 321,037
G. Wool, raw and waste, and woollen rags	11,578,968	13,210,666	14,471,239	+ 1,260,573	+ 2,892,271
H. Silk, raw, knubs and noils	9,557	5,048	15,139	+ 10,091	+ 5,582
I. Other textile materials	591,589	484,552	628,791	+ 144,239	+ 37,202
J. Seeds and nuts for oil, oils, fats, resins and gums	1,248,847	720,737	683,322	— 37,415	— 565,525
K. Hides and skins, undressed	8,279,600	9,388,376	11,653,088	+ 2,264,712	+ 3,373,488
L. Paper-making materials	40,363	61,331	50,817	— 10,184	+ 10,484
M. Rubber	2,858,530	4,916,366	4,392,242	— 524,124	+ 1,533,712
N. Miscellaneous raw materials and articles mainly unmanufactured	1,249,634	1,391,118	1,565,927	+ 174,809	+ 316,293
Total, Class II	29,132,105	32,931,899	36,913,721	+ 3,978,822	+ 7,781,616
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—					
A. Coke and manufactured fuel	147	251	787	+ 533	+ 610
B. Pottery, glass, abrasives, &c.	59,902	66,223	65,370	— 853	+ 5,468
C. Iron and steel and manufactures thereof	80,176	266,312	138,682	— 127,630	+ 58,506
D. Non-ferrous metals and manufactures thereof	4,030,876	6,125,801	13,593,555	+ 7,467,754	+ 9,562,679
E. Cutlery, hardware, implements and instruments	723,223	736,866	815,233	+ 78,367	+ 92,010
F. Electrical goods and apparatus	83,381	91,850	110,895	+ 16,045	+ 27,514
G. Machinery	851,644	890,665	952,466	+ 61,801	+ 100,822
H. Manufactures of wood and timber	162,625	169,659	206,443	+ 36,784	+ 43,818
I. Cotton yarns and manufactures	143,963	181,474	291,809	+ 107,335	+ 147,846
J. Woollen and worsted yarns and manufactures	522,345	609,724	666,983	+ 57,259	+ 144,638
K. Silk yarns and manufactures	289,180	198,510	187,632	— 10,878	— 101,548
L. Manufactures of other textile materials	544,009	491,544	553,128	+ 61,584	+ 9,119
M. Apparel	549,056	528,893	506,110	— 22,783	— 42,946
N. Chemicals, drugs, dyes and colours	400,701	403,645	469,663	+ 66,018	+ 68,962
O. Oils, fats and resins, manufactured	1,706,022	1,812,897	2,127,513	+ 314,616	+ 421,491
P. Leather and manufactures thereof	1,048,597	1,073,288	1,198,651	+ 125,363	+ 150,054
Q. Paper, cardboard, &c.	63,484	67,860	74,907	+ 7,047	+ 11,423
R. Vehicles (including locomotives, ships and aircraft)	143,964	167,780	293,053	+ 125,273	+ 149,089
S. Rubber manufactures	20,481	14,590	13,871	— 719	— 6,610
T. Miscellaneous articles wholly or mainly manufactured	1,912,560	1,929,529	2,176,778	+ 247,249	+ 264,218
Total, Class III	13,336,336	15,833,364	24,443,529	+ 8,610,165	+ 11,107,193
IV. ANIMALS NOT FOR FOOD	278,633	324,541	628,093	+ 303,552	+ 349,460
Total	55,302,619	60,768,859	75,166,655	+ 14,397,796	+ 19,864,036

BANK OF ENGLAND

Pursuant to the Act 7th and 8th Victoria, cap. 32 (1844),

(000's omitted)

1	2	3	4	5	6	7	8
Issue Department						Collateral Columns	
Liabilities		Assets					
Notes Issued	Dates (Wednesdays)	Govt. Debt (£11,015) and Govt. Securities	Other Securities	Gold Coin and Bullion	Silver Coin	Notes in Hands of Public	Minimum Discount Rate
£		£	£	£	£	£	Per cent.
513,661	Jan. 6.........	199,888	101	313,661	11	462,703	2
513,661	„ 13.........	199,939	51	313,661	10	455,047	
513,661	„ 20.........	199,616	374	313,661	10	450,464	
513,661	„ 27.........	198,960	1,026	313,661	14	452,297	
513,661	Feb. 3.........	198,895	1,091	313,661	14	457,311	
513,661	„ 10.........	198,951	1,039	313,661	10	454,994	
513,661	„ 17.........	197,890	2,101	313,661	9	453,338	
513,661	„ 24.........	197,594	2,393	313,661	13	455,067	
513,661	Mar. 3.........	197,667	2,323	313,661	10	460,955	
513,661	„ 10.........	198,026	1,965	313,661	9	464,475	
513,661	„ 17.........	198,091	1,900	313,661	9	463,815	
513,662	„ 24.........	198,169	1,823	313,662	8	470,526	
513,662	„ 31.........	197,977	2,013	313,662	10	473,837	
513,662	Apr. 7.........	196,868	3,124	313,662	8	469,970	
513,662	„ 14.........	196,916	3,074	313,662	10	465,694	
513,662	„ 21.........	196,911	3,082	313,662	7	464,024	
513,662	„ 28.........	196,968	3,021	313,662	11	468,816	
513,662	May 5.........	195,129	4,860	313,662	11	475,159	
518,662	„ 12.........	195,159	4,834	318,662	7	479,909	
521,261	„ 19.........	194,622	5,367	321,261	11	481,433	
521,261	„ 26.........	194,660	5,331	321,261	9	475,220	
521,261	June 2.........	194,740	5,246	321,261	14	475,553	
521,261	„ 9.........	195,103	4,885	321,261	12	476,541	
521,261	„ 16.........	195,156	4,835	321,261	9	479,781	
526,407	„ 23.........	195,112	4,878	326,407	10	483,720	
526,407	„ 30.........	195,152	4,839	326,407	9	488,444	
526,407	July 7.........	195,098	4,889	326,407	13	494,424	
526,407	„ 14.........	195,162	4,829	326,407	9	493,406	
526,407	„ 21.........	195,064	4,925	326,407	11	493,134	
526,407	„ 28.........	195,150	3,836	326,407	14	498,339	
526,407	Aug. 4.........	196,801	3,193	326,407	6	503,877	
526,407	„ 11.........	198,139	1,852	326,407	9	497,867	
526,407	„ 18.........	198,482	1,505	326,407	13	490,975	
526,407	„ 25.........	199,311	679	326,407	10	488,267	
526,407	Sept. 1.........	199,287	703	326,407	10	490,310	
526,407	„ 8.........	199,309	678	326,407	13	489,148	
526,407	„ 15.........	199,661	327	326,407	12	488,153	
526,407	„ 22.........	199,669	320	326,407	11	485,970	
526,407	„ 29.........	199,686	304	326,407	10	488,471	
526,407	Oct. 6.........	199,693	297	326,407	10	491,834	
526,407	„ 13.........	199,409	579	326,407	12	489,859	
526,407	„ 20.........	199,445	542	326,407	13	484,346	
526,407	„ 27.........	199,244	746	326,407	10	483,148	
526,407	Nov. 3.........	199,130	857	326,407	13	485,909	
526,407	„ 10.........	199,153	838	326,407	9	485,573	
546,407	„ 17.........	219,152	838	326,407	10	481,108	
546,407	„ 24.........	218,752	1,238	326,407	10	480,374	
546,407	Dec. 1.........	219,339	649	326,407	12	485,676	
546,407	„ 8.........	219,700	289	326,407	11	492,831	
546,407	„ 15.........	219,702	288	326,407	10	501,954	
546,407	„ 22.........	219,701	287	326,407	12	509,316	
546,407	„ 29.........	219,703	287	326,407	10	505,317	

WEEKLY RETURN

for Wednesday in each Week, during the Year **1937**

(000's omitted)

9	10	11	12	13	14	15	16	17	18
BANKING DEPARTMENT									
Liabilities				DATES (Wednesdays)	Assets				Totals of Liabilities and Assets
Capital (£14,553) and Rest	Public Deposits	Banker's Deposits	Other Deposits		Govt. Securites	Discounts and Advances	Other Securities	Reserve (Notes and Coin)	
£	£	£	£		£	£	£	£	£
18,078	13,525	110,230	38,401	Jan. 6	93,295	14,413	21,105	51,421	180,234
18,099	12,384	106,720	38,266	„ 13	83,156	12,521	20,806	58,986	175,469
18,127	13,555	100,287	37,568	„ 20	74,935	8,906	22,079	63,617	169,537
18,143	12,133	98,423	38,442	„ 27	78,636	8,018	18,724	61,763	167,141
18,160	12,214	96,106	38,274	Feb. 3	80,449	8,521	18,928	56,856	164,754
18,178	11,695	99,157	37,345	„ 10	81,230	6,509	19,517	59,119	166,375
18,211	24,394	90,551	36,657	„ 17	83,128	5,467	20,382	60,836	169,813
18,231	12,970	100,419	37,876	„ 24	85,013	4,915	20,273	59,267	169,498
18,246	15,175	93,768	37,700	Mar. 3	85,090	4,295	21,942	53,562	164,889
18,266	16,958	93,827	37,667	„ 10	90,074	4,246	22,299	50,099	166,718
18,282	22,846	93,969	37,257	„ 17	94,854	3,765	22,933	50,802	172,354
18,286	27,909	81,986	37,568	„ 24	94,549	4,756	22,350	44,093	165,749
18,305	52,246	62,347	38,462	„ 31	100,529	7,138	22,884	40,809	171,360
17,672	24,512	94,831	38,367	Apr. 7	101,072	7,395	22,301	44,614	175,382
17,692	22,371	96,807	37,921	„ 14	96,950	6,906	22,147	48,878	174,881
17,706	25,585	91,182	38,869	„ 21	94,064	4,595	24,014	50,669	173,342
17,714	26,161	87,566	39,578	„ 28	97,730	5,468	21,968	45,851	171,019
17,734	16,381	97,175	37,661	May 5	103,096	5,441	20,962	39,452	168,951
17,753	32,520	87,664	37,185	„ 12	108,338	5,893	21,275	39,616	175,122
17,774	19,194	97,431	37,580	„ 19	103,272	6,571	21,420	40,716	171,979
17,789	24,864	91,372	37,480	„ 26	99,472	4,865	20,267	46,901	175,505
17,813	10,232	109,499	37,301	June 2	102,822	4,749	20,736	46,537	174,845
17,831	10,687	107,428	36,776	„ 9	101,203	4,833	21,074	45,612	172,722
17,884	10,014	102,261	37,151	„ 16	101,329	3,738	19,854	42,389	167,310
17,918	15,459	94,987	37,186	„ 23	98,027	3,756	20,178	43,589	165,550
17,965	10,785	140,533	40,155	„ 30	140,603	6,279	23,680	38,876	209,438
18,013	15,255	88,511	37,155	July 7	96,625	9,035	20,434	32,870	158,964
18,048	23,121	89,173	37,129	„ 14	103,960	8,819	20,743	33,949	167,471
18,061	17,502	97,181	38,150	„ 21	107,419	5,830	23,309	34,246	170,894
18,104	10,528	104,259	37,322	„ 28	114,410	5,812	20,815	29,177	170,215
18,145	9,810	95,490	36,995	Aug. 4	110,205	6,445	20,146	23,644	160,440
18,164	19,036	93,574	36,363	„ 11	111,130	5,907	20,340	29,761	167,137
18,183	28,540	88,500	36,531	„ 18	107,137	6,187	21,629	36,801	171,754
18,198	25,377	92,819	35,998	„ 25	108,837	4,318	19,643	39,594	172,392
18,233	14,111	101,173	36,531	Sept. 1	109,275	5,368	20,755	37,651	173,048
18,245	11,969	105,702	36,256	„ 8	107,142	5,121	21,030	38,878	172,172
18,254	12,463	108,397	36,091	„ 15	109,073	5,038	21,199	39,895	175,205
18,271	15,664	105,601	36,243	„ 22	106,868	5,208	21,641	42,062	175,779
18,289	21,805	95,122	37,179	„ 29	105,838	6,191	20,768	39,598	172,395
17,648	17,954	102,130	36,805	Oct. 6	106,533	10,837	20,897	36,270	174,537
17,665	26,060	92,921	36,413	„ 13	105,088	9,248	20,437	38,286	173,059
17,680	29,774	89,329	36,252	„ 20	99,603	6,468	23,250	43,714	173,035
17,685	32,174	87,679	36,595	„ 27	100,238	8,109	20,909	44,877	174,133
17,715	30,285	89,435	36,632	Nov. 3	103,413	7,820	20,751	42,083	174,067
17,744	30,679	90,909	36,094	„ 10	103,908	8,413	20,743	42,362	175,426
17,767	33,172	86,698	36,142	„ 17	76,613	9,020	21,301	66,845	173,779
17,805	35,358	83,598	36,348	„ 24	76,153	8,601	20,868	67,487	173,109
17,851	11,985	105,673	36,565	Dec. 1	78,823	10,522	20,708	62,021	172,074
17,877	11,742	106,310	36,658	„ 8	87,243	9,641	20,955	54,748	172,587
17,906	11,432	103,381	36,463	„ 15	95,008	7,849	20,717	45,608	169,182
17,947	10,772	98,216	36,497	„ 22	96,458	7,486	21,500	37,988	163,432
17,994	11,384	120,641	36,567	„ 29	114,598	9,205	20,867	41,916	186,586

FOREIGN EXCHANGES.—*Quotations as under,* LONDON *on Paris, Berlin and Calcutta; New York and Hong Kong on* LONDON, **1937**

DATE (Thursdays)	1	2	3	4	5	6	7
	London on Paris	London on Berlin	London on Calcutta	New York on London	Hong Kong on London	Price per Ounce	
	Cables (middle rate)	Cables (middle rate)	Demand (middle rate)	Cables (closing rate)	T.T.	Gold Bars (fine)	Silver Standard Bars (cash)
1937.	*f. c.*	*Reichmarks.*	*s. d.*	*$ c.*	*s. d.*	*s. d.*	*s. d.*
Jan. 14......	105 5/32	12·20½	1 6⅛	4·96 5/32	1 3	141 8	1 8⅝
„ 28......	105 5/32	12·17½	„	4·90 1/32	1 3	141 11	1 8½
Feb. 11......	105 3/64	12·17½	„	4·89 21/32	1 2 15/16	141 11	1 8⅛
„ 25......	105 5/32	12·16	„	4·88 31/32	1 2 15/16	142 2½	1 8⅛
Mar. 11......	106 9/16	12·14½	„	4·88 13/32	1 2 15/16	142 4½	1 8½
„ 25......	106 21/64	12·15	„	4·88 19/32	1 2 15/16	142 4	1 8 9/16
Apr. 8......	107 ⅜	12·17½	„	4·89 19/32	1 2 15/16	141 9	1 9⅛
„ 22......	111 ¼	12·29½	„	4·93 25/32	1 2 15/16	141 7½	1 8 5/16
May 6......	110 1/32	12·28¼	„	4·93⅞	1 2 15/16	140 8½	1 8 7/16
„ 20......	110 13/16	12·30	„	4·94	1 2 15/16	140 6½	1 8 5/16
June 3......	110 ⅝	12·27½	„	4·92⅜	1 2 13/16	140 9	1 8⅜
„ 17......	110 23/32	12·31½	„	4·93 13/16	1 2 13/16	140 6½	1 7 13/16
July 1......	128 29/32	12 33	„	4·94½*	1 2¾	140 6	1 7 15/16
„ 15......	128 3/64	12 34⅝	„	4·96 11/16	1 2 11/16	140 1½	1 7 15/16
„ 29......	132 13/16	12·36½	„	4·97 11/16	1 2 11/16	139 9½	1 8 1/16
Aug. 12......	132 27/32	12·39	„	4·98 7/16	1 2 15/16	139 6	1 7 15/16
„ 26......	132 ⅞	12·39	„	4·98 1/16	1 2 15/16	139 7	1 7⅝
Sept. 9......	135 ⅞	12·33¼	„	4·94¾	1 3	140 4	1 7 15/16
„ 23......	144 31/32	12·33½	„	4·94⅞	1 3	140 6	1 7 13/16
Oct. 7......	150 7/32	12·33¼	„	4·95 7/16	1 3	140 6½	1 7 15/16
„ 21......	146 7/32	12·33¼	„	4·95 5/16	1 3	140 7	1 7 15/16
Nov. 4......	147 9/32	12·35½	„	4·97¾	1 3	140 6½	1 7 13/16
„ 18......	147 ⅜	12·37¾	„	5·00 1/16	1 3	140 0	1 7 11/16
Dec. 2......	147 7/64	12·38½	„	4·99 5/16	1 3	140 0	1 7⅝
„ 16......	147 17/64	12·39½	„	4·99¾	1 3	139 9½	1 6 11/16
„ 30......	147 9/32	12·41	„	4·99¼	1 3	139 6	1 6 9/16

* July 2nd.

JOURNAL

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A New Index Number of Agricultural Prices

By C. T. Houghton

[Read before the Royal Statistical Society, January 18th, 1938, the President, the Rt. Hon. Lord Kennet of the Dene, P.C., G.B.E., D.S.O., D.S.C., in the Chair.]

This paper deals with the changes that have been made in the Ministry of Agriculture and Fisheries index numbers of agricultural prices in a new series that will be published shortly. It briefly describes the methods of calculating the old series, the reasons for undertaking a revision, the procedure adopted for dealing with the problem of revision and the conclusions reached on the various questions calling for a decision.

I. *The Nature and History of the Old Series*

Since 1913 the Ministry of Agriculture and Fisheries has published three series of index numbers of prices, viz. (1) of agricultural produce sold by the home farmer, (2) of feeding-stuffs purchased by the home farmer, and (3) of fertilizers purchased by him. The calculations were carried back to the year 1906. These index numbers covered individual commodities and groups of commodities. The general index for agricultural produce takes the form of a weighted arithmetic average of the price changes of agricultural produce as a whole compared with prices in the base period. The weights used for the general index of agricultural produce are proportional to the values of the gross output of the constituent commodities as ascertained at the Agricultural Census of 1908. In this connection the term " gross output " covers the produce sold by farmers to the non-farming community, together with the produce consumed in farm households. The weights used for the group index numbers of fertilizers and feeding-stuffs are proportional to the estimated expenditure of farmers on the various items purchased from the non-farming community just before the War.

The price quotations on which the index numbers are based are, with few exceptions, compiled weekly from information collected by the Ministry's reporters at representative markets throughout England and Wales. Most of the quotations used represent prices at country markets. Where quotations for several qualities are given, those used for the index number in most cases relate to second-quality produce, second quality having been regarded as representative of the average of the whole. The quotations are averaged for the month and the year by taking the simple arithmetic average of the average weekly quotations, and index numbers for the individual commodities (or in some cases groups of commodities) are calculated. From these individual indices a weighted arithmetic average is taken for the purpose of calculating a general index for agricultural produce as a whole, the items being weighted in accordance with their proportional value in the value of the total agricultural output of 1908. Index numbers are calculated for each month, for the calendar year and for the harvest year (September to August). The monthly indices do not include those commodities that are not sold in each month of the year.

When the index numbers were instituted, the base period from which the price changes were measured was the three years 1906–08, average prices during that period being equated to 100; but in 1919, in order to facilitate comparison with conditions immediately before the War, the base period was shifted to the three years 1911–13, without, however, any change being made in the weighting.

An alteration in the monthly index was made in 1922, when the original method of calculation, which used the same base period for the monthly as for the annual indices, was abandoned, and each monthly index was based instead on average prices for the corresponding months of the base period. Thus, in effect, the base period of the monthly index changes from month to month. This method was introduced with a view to eliminating from the monthly index the effect of regular seasonal variations of prices.

No further change affecting the method of calculation was made in the old series. In one or two instances, however, it has been necessary to use quotations relating to different varieties of produce from those originally included. And since the establishment of agricultural marketing schemes, the figures published by the Marketing Boards have been substituted in some cases for the market quotations formerly used.

II. *The Need for Revision*

With the passage of time, these index numbers have, in some respects, become defective, and the question of revision has been under consideration by the Ministry for some time. The defects are due to the changes that have taken place in home agriculture since the War. The most important change in this respect is in the make-up of the total agricultural output, in consequence of which the weighting used for calculating the general index for agricultural produce as a whole is no longer appropriate to present-day conditions. Another important change, due principally to the establishment of the Milk Marketing Board, affects the validity of the Ministry's price quotations for milk. Experience has shown that the monthly index is also to some extent defective.

TABLE I

Value of each of the Main Items of the Agricultural Output in 1908 *and in* 1935–36, *Expressed as a Percentage of the Total Value of those Items*

	Output of 1908	Output of 1935–36
Wheat	6·5	2·7
Barley	4·9	1·8
Oats	1·6	0·7
Beans and Peas	0·8	0·2
Hay	9·0	1·5
Potatoes	4·9	7·2
Hops	0·8	1·1
Total farm crops	28·5	15·2
Fat Cattle	20·3	13·2
Fat Sheep	10·6	7·8
Fat Pigs	10·6	11·7
Total Livestock	41·5	32·7
Milk	17·1	26·0
Butter	2·4	2·2
Cheese	0·8	1·0
Total dairy products ...	20·3	29·2
Poultry	1·6	3·1
Eggs	1·6	8·5
Total poultry and eggs ...	3·2	11·6
Fruit	3·3	2·5
Vegetables	0·8	7·8
Wool	2·4	1·0
	100·0	100·0

The existing system of weighting, based as it is on the estimated agricultural output of the year 1908, reflects the relative importance of the different constituents of the output not at the present time, but 30 years ago. But considerable changes in the relative importance of those constituents have taken place since 1908. Farm crops have declined in importance, and such products as milk, eggs and certain varieties of vegetables have risen. Sugar beet is now an important item in the agricultural output in the eastern counties of England; in 1908 the production of sugar beet was negligible.

Table I shows the items used for the weighting of the general index of agricultural produce in the old series, and the value of the "output" of each item expressed as a percentage of the whole of them for the outputs of 1908 and of 1935–36.

The table shows that the old index gives an excessive weight to farm crops and livestock and an insufficient weight to dairy products, poultry, eggs and vegetables. Among the individual products wheat, barley, hay, fat cattle and wool are over-weighted, and milk, eggs and vegetables are under-weighted.

To the extent that farmers vary the nature of their production in response to relative price movements, increasing their production of those commodities the price of which has risen most or fallen least, and decreasing that of others, it is to be expected that a pre-War weighting system will give a lower index number for post-War years than one based on more recent data, since it will give greater weight to the items whose prices are relatively low, and less to those whose prices are relatively high. A comparison of the existing index with one in which weights derived from the output of the year 1935–36 are employed is given in Table II. The revised index here given is in scope and method of construction identical with the

TABLE II

Comparison of Agricultural Price Index Numbers Constructed on Two Systems of Weighting

(1911–13 = 100)

Year	Old Index with 1908 Weights	Revised Index with 1935–36 Weights
1925	159	167
1926	151	158
1927	144	149
1928	147	154
1929	144	152
1930	134	140
1931	120	131
1932	112	126
1933	107	119
1934	114	125
1935	117	129
1936	122	136

old index, except that the weights used for calculating the figures in the third column have been derived from the output of 1935–36.

It will be seen that the difference between the two series is considerable. It shows that the rise in prices between 1911–13 and 1935–36 using weights derived from the output of the latter year amounted to 36 per cent., whereas measured by the old index the rise was only 22 per cent. The discrepancies between the methods of the two series from year to year are, of course, naturally much less than those shown in the comparison of each year with 1911–13.

Which of these two methods of weighting is to be regarded as giving the more accurate comparison in a purely theoretical sense between pre-War years and the present may, perhaps, be open to argument; but a system of weighting based on the output of the present day is, at all events, more relevant to agricultural conditions as they now exist. Moreover, although in the early years after the War comparisons with pre-War years were of great importance, these comparisons have now become of less importance than comparisons of price movements in the relatively recent years. For the measurement of the latter the use of pre-War weights is clearly inappropriate.

In short, the weighting of the agricultural index number has become out of date owing to the fact that the agricultural output has changed, just as the weighting of the cost-of-living index number may have become out of date owing to changes in the budgets of working-class families since 1914.

The question of the appropriate system of weights to adopt for the future raises the question of what should be the price period base for the new series; whether the new series should be linked with the old with no apparent break in the two, or whether the new series and the old should overlap so that some comparison could be made between them. All these questions required consideration. The inaccuracy of the index number for milk (with which I shall deal later) was becoming increasingly embarrassing. It was decided, therefore, that the whole system of compiling the index numbers should be reviewed, so that any changes that might be considered to be necessary could all be made at the same time.

III. *The Procedure for Dealing with the Problem*

In the first place, a memorandum was prepared in the Department as a basis for discussion setting out the nature of the problems calling for consideration and the relative merits of various methods of dealing with them. This memorandum was circulated to three or four of the Ministry's officers immediately concerned, who subsequently met together on several occasions and discussed the various points raised in it. As a result of these discussions a revised self-contained memorandum was prepared which included the tentative conclusions of the officers referred to. This memorandum was submitted to the Minister for his information, with a recommendation that although the officers concerned had reached certain conclusions, it appeared to be desirable, in view of the importance of the changes proposed, that the question should be further considered by an *ad hoc* Advisory Committee appointed by the Minister. The Minister accordingly appointed an Advisory Committee with the following term of reference :—

> " To consider whether it is desirable to revise the present methods of computing the Ministry of Agriculture's index numbers of prices of agricultural produce and of feeding-stuffs and fertilizers, and, if so, to make recommendations on the subject."

The Committee was constituted as follows :—

Mr. C. T. Houghton (Chairman)	Ministry of Agriculture and Fisheries.
Mr. F. Grant	
Mr. E. F. Nash	
Mr. J. M. Ramsay	Department of Agriculture for Scotland.
Mr. D. A. E. Harkness	Ministry of Agriculture for Northern Ireland.
Mr. H. Leak	Board of Trade.
Mr. J. H. Wain	National Farmers' Union.
Miss C. G. Gatey	
Mr. W. Holmes	National Union of Agricultural Workers.
Mr. T. H. Hodgson	Agricultural Workers' Section of the Transport and General Workers' Union.
Prof. A. W. Ashby	Department of Agricultural Economics, University College of Wales.
Prof. A. L. Bowley	
Mr. R. H. Mares (Secretary) ...	Ministry of Agriculture and Fisheries.

It will be seen that, in addition to the three officers of the Ministry of Agriculture and Fisheries who had been most closely concerned with the examination of the subject, representatives of the two other Agricultural Departments and of the Board of Trade were also included. Up to the present the Agricultural Departments in Scotland and Northern Ireland have not produced any index numbers of agricultural prices for their respective areas. The Department of Agriculture for Scotland had in view, however, the institution of a series of index numbers, and appointed an Advisory Committee of its own to consider the subject in Edinburgh during the same period as the London Committee was sitting. Each Committee was kept informed of what the other was doing by the representative of the Scottish Department, who served as a member of both Committees. The problem was thus discussed simultaneously and on parallel lines in England and in Scotland. The Ministry of Agriculture in Northern Ireland was also considering the question of compiling agricultural index numbers, and that Ministry has since decided to commence the publication of index numbers of prices compiled in the manner recommended by the Committee. The Board of Trade publish index numbers of prices, and consequently have to deal with many questions that are similar to the questions to be dealt with in connection with the agricultural index. The appointment of these departmental representatives, therefore, ensured the co-operation of the Departments concerned with the problems involved.

The National Farmers' Union and the Agricultural Workers' Unions are, of course, particularly interested in the agricultural index numbers. These Unions represent the bulk of the "consumers" of these particular statistics, and it was considered very desirable to have the benefit of the advice of these representative bodies, and essential that they should be fully informed of what the Ministry proposed to do, so that the new series would, it was hoped, be accepted by them as satisfactory, and would consequently inspire confidence in the agricultural community. In addition, it was considered desirable to obtain advice from the academic world, and the Ministry was fortunate in securing the services of Professor Bowley and Professor Ashby in this connection.

It is of interest to mention here that of the twelve members of the Committee seven are Fellows of this Society.

Three weeks before the date of the first meeting of the Committee a copy of the memorandum that was prepared primarily for the Minister's information, to which I have already referred, was circulated to the members of the Committee, so that they would be fully informed beforehand of the subject-matter of their discussions. Consequently no time was lost in getting down to business when the Committee met. The Committee completed its task in three meetings held over a period of five weeks. Each meeting occupied a whole day, so as to save the time of those members who had to travel a long distance to London. The intervals between meetings were occupied with the preparation of memoranda or statistical tables for the Committee. In view of the fact that the discussions were based largely on the Departmental memoranda, and that they were summarized in the minutes, it was not considered necessary to present a Report. Although on some points one or two of the members would have preferred to suggest the adoption of a different course from that favoured by the majority, none of them carried his preference to the point of dissent; with the foregoing qualification, therefore, it may be said that all the recommendations of the Committee were unanimously agreed to after full discussion. The expedition with which the Committee completed its task may, I think, be attributed to the full preliminary exploration of the subject in the Ministry.

In preparing this paper I have drawn largely on the Departmental memoranda, and I should like to acknowledge my indebtedness to my colleagues both in the Department and on the Committee for their contributions towards the consideration of this subject.

IV. *Some General Observations*

Before I proceed to deal with the various questions considered by the Committee, I should like to make a few general observations. The first question that naturally arises at the outset of a review of the existing system is: What is the purpose of the index numbers? The simple answer is obvious enough; it is to show in a form that would be appreciated at a glance the changes in price of a commodity, or group of commodities, that have taken place from time to time during the period covered by the series. An index number of prices would appear in its purest and simplest form if it represented one commodity that was homogeneous throughout the series, and if the prices to be compared were in each case either in respect of one transaction or of transactions all at the same price. If the transactions represented by any number in the series were at different prices, an average price would have to be struck before the number could be determined, and, in that event, the quantities sold in the different transactions would affect the average price. Varying prices in the different transactions are usually due to differences of quality, but not always, particularly in the case of perishable produce. For example, the price of fruit or vegetables in a producer's wholesale market may slump heavily after the departure of the trains to the main consuming centres, owing to a diminution of demand. So far as quality is concerned, the average quality of the different lots of a particular commodity offered for sale in a particular market may be different on two different days, and the prices on the two days might consequently be expected to differ, even though the conditions of demand may remain the same. In this case the commodity is not homogeneous throughout the series. The Ministry has attempted to overcome this difficulty to some extent by the institution of separate quotations for first-, second- and third-quality produce, as the following extract from the Instructions to Market Reporters shows:—

> "The Ministry attaches great importance to the question of classification of livestock and other produce into First, Second and Third qualities, and is anxious that uniformity of

> grading should obtain over the whole country. Reporters are reminded that the standard of quality for which quotations are given should not vary from week to week. It may, therefore, sometimes happen that there may be no 'First Quality'—as understood for the purpose of these reports—in the market and that the best animals or commodities sold may rank only as 'Second' or even 'Third' quality. In that case the omission of quotations for First quality should be explained in the notes."

The gradations of quality, however, are usually too numerous for the difficulty to be eliminated entirely in this way.

Some of these changes in average quality may be regular owing to seasonal influences, or they may be irregular owing to casual changes in weather conditions or to other causes. Fat cattle provide an example of regular seasonal changes subject to an exception in recent years to which I shall refer later, and barley provides an example of both regular and irregular changes.

The average price of fat cattle in the spring months is usually higher than in the autumn, owing, to a large extent, to the superior average quality of the beasts that have been stall fed during the winter compared with those in the autumn coming into the market off the grass. The "fat cattle" covered by the index in the spring are, therefore, in the main not exactly the same kind of animals as the "fat cattle" in the autumn.

The position with regard to barley is more complicated. The best-quality barley is used for malting; most of the rest is used for stock feeding or distilling. But there is no definite line of demarcation between malting barley and feeding barley; the one fades off into the other through many gradations of quality. Barley of medium quality may be used for either one purpose or the other, according to the state of the market, which is influenced chiefly by the volume of the available supplies of barley of good malting quality, whether home-produced or imported, and according to the stocks already held by brewers or maltsters in relation to the estimated available supply. The price of barley sold for malting is usually much higher than that sold for feeding, and the price of malting barley varies considerably, according to its quality. But it is all barley, and so far as the statutory prices collected by the Ministry of Agriculture and Fisheries under the Corn Returns Acts are concerned, no differentiation is made between barley for malting and barley for feeding; indeed, for the reasons given, it would be difficult, if not impossible, to do so. So far as price and ultimate use are concerned, we have here practically two distinct commodities both covered by the index number for barley. There is the further point that it is usual for the best malting samples to be sold soon after the harvest, and there is usually a regular decline in the average prices throughout the cereal year.

I have already explained that an attempt has been made to eliminate the effect of regular seasonal variations from the monthly index numbers. It is impossible to eliminate the effect of changes of quality due to more fortuitous circumstances.

It is clear, therefore, that the index number for a particular commodity will, in many cases, represent changes of price that are due to changes in quality as well as changes in quantity and changes in demand; the index number frequently does not represent a commodity that is homogeneous throughout the series.

When we come to the agricultural output as a whole, we have a collection of goods the constituents of which are different in kind as well as in quality. In calculating the general index number for agricultural produce, it is obviously impossible first to calculate one average price for all the commodities, seeing that there is no common unit of quantity. One cannot calculate the average price of a quarter of wheat, a gallon of milk and a hundredweight of live fat beast. The only common basis is value. In defining the purpose of the general index number for agricultural produce as a whole, we say that the purpose of this index is to measure as accurately as possible the influence of price changes on the value of the agricultural output. I emphasize the phrase "as accurately as possible," because there is clearly no perfect method of measuring the price changes of a group of commodities whose constituents vary so widely as those of agricultural produce. Imperfection is unavoidable; we must do the best we can.

Imperfection may also occur in the quotation of prices. The agricultural statistician is dependent for a very large part of his information on prices not on true weighted averages, but on what is, in the opinion of a market reporter, the average market price of the commodity in question on a particular day. There is a possibility of error here owing to imperfection of personal judgment, and in many cases, particularly as regards fruit and vegetables, to the inherent difficulty of the task. But for most of the commodities the number of reporters is large, so that the results of individual bias probably cancel out, and the reporters do not change frequently, so that even if individual bias does exist, it should not affect the comparisons between prices at different times, which it is the function of the index numbers to show.

The calculation of average prices of fruit presents a good example of the inherent difficulties of the reporter's task. Separate indices are calculated for eight different kinds of fruit. First- and second-quality average prices of these are obtained weekly, when possible, throughout the season from the Ministry's reporters at representative town markets. Some of these commodities are subject to a wide seasonal range of prices. For example, strawberries are usually highly priced at the beginning of the season and become rapidly cheaper as the supplies increase. The compilation of an average price is consequently difficult. If the early quotations, which are few in number, were included, they might unduly affect the seasonal average unless that average were weighted accordingly to quantities sold at the respective prices. Such weighting is impossible owing to the lack of information. It is essential, therefore, to scrutinize all prices at the extremes of the seasons and to exclude any exceptional quotation likely to have an undue effect upon the seasonal average. As guides to exceptionality there are the number of markets quoting for the week in question and the reporters' comments upon the conditions of the markets. Although it is not possible to adopt rigid rules, it may be stated that where about 50 per cent. of the representative markets quote prices in any one week, those prices are accepted for the calculation of the seasonal average. To get as near as possible to a weighted seasonal average price, the seasonal average is computed by totalling all accepted quotations and dividing the sum by the number of quotations.

What has been said about fruit applies in more or less the same degree to vegetables and glasshouse produce. Each item is dealt with separately, but broadly speaking quotations are included or excluded according to the volume of the trade as shown by the number of markets quoting and according to the state of the markets as noted by the local reporter.

In spite of the difficulties, my own view is that the average prices quoted by the Ministry attain a satisfactory standard of accuracy. I have derived considerable comfort from a comparison I have made since the beginning of the fat-cattle subsidy in 1934 between the average weekly price of the fat cattle in respect of which subsidy has been paid and a simple average of first and second-quality fat cattle (which covers practically the same types of beasts) as obtained from the reports of the Ministry's reporters. In connection with the fat-cattle subsidy the weight of the beast and the price for which it was sold have to be declared, so that it is possible to calculate a true weighted average price for any particular period. It is very satisfactory to know that the two curves of weekly average prices since the beginning of the subsidy on September 1st, 1934, practically coincide.

These general observations are relevant to some of the particular problems that the Advisory Committee had to consider. I mention them to show that the Ministry's price indices cannot be perfect in the theoretical sense, and that we have to be content with approximations. It is therefore unnecessary, and, indeed, it would be misleading to adopt methods in the calculation of the index that would imply a degree of accuracy in the figures that cannot be claimed for them.

V. *The Conclusions of the Committee*

The type of Average. The first question to be considered by the Committee was the type of average to be used. The arithmetic average is used in the existing series. The geometric average has, however, been adopted for a number of price-index numbers in recent years, though not, so far as I am aware, for any index numbers of agricultural produce. The lead for a change over from the arithmetic average to the geometric average in this country was, I think, given by the Board of Trade soon after the War. The advantages of the geometric average over the arithmetic for the compilation of price index numbers in general were pointed out by Jevons as far back as 1865. In a paper read before this Society in January 1921,* Sir Alfred Flux set out the reasons for the adoption of the geometric average in place of the arithmetic in the compilation of the new Board of Trade index number of wholesale prices.

Many of the advantages of the geometric average for the purpose of the Board of Trade index do not apply to the agricultural index. This is due mainly to the different purposes of the two series. The aim of the Board of Trade series, as explained by Sir Alfred Flux in his paper, is "to ascertain in reference to wholesale prices what is the extent of the influence of the general economic position on all prices." The purpose of the agricultural index is, as I have already stated, to measure the influence of price changes on the value of the agricultural output. Sir Alfred Flux himself drew a clear distinction between these two purposes, though in doing so he compared with the Board of Trade index of wholesale prices not the agricultural index number, but the index number of retail prices. Referring to the index numbers of retail prices, he pointed out that one of the questions to which a series of index numbers could supply the answer was: "What is the change in the money cost of the things we buy due to the price changes since any given date in the past?" The answer to this question, he said, was to be found quite naturally in the comparative money cost of a fixed schedule of articles at different times; consequently an index number calculated on the lines of a weighted arithmetic average, with prices expressed as percentages of those of a period selected as the reference period, is the natural method of calculating the measure of change. For retail prices, he added, no other procedure is likely to commend itself as obviously appropriate. If we insert in the foregoing question the words " money value of the things we sell " for " money cost of the things we buy," we get the sort of question that our farmers expect the agricultural index number to answer, viz. " What is the change in money value of the things we sell due to the price changes since any given date in the past ? ", and the answer to this question is, in fact, what the agricultural index number purports to give. The arithmetic average is obviously appropriate for this purpose. It has the further incidental advantage that it is more easily understood by the layman and involves no change in the existing method. The Committee had no hesitation in recommending its continuance.

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* *J.R.S.S.*, lxxxiv, 167 *et seq.*

In this connection it is interesting to note that when, in 1934, the index number of the prices received by farmers was revised by the Agricultural Department in the United States by the inclusion of additional commodities and the introduction of more up-to-date weights, the arithmetic average was retained.*

The Base Period. Having decided that the arithmetic average was to be retained, and on the assumption that the weighting system was to be brought up to date, the next question was what would be the most suitable price base period. In measuring changes in agricultural prices, which are liable to vary considerably from year to year owing to climatic causes, the use of a single year has obvious disadvantages. It is desirable that the index number should be based on an average of several years, as is done in the existing series. The most usual and most useful point of reference in economic discussion at the present time is probably the period preceding the world depression that began in 1929. Between 1925 and 1929 the world enjoyed comparative economic stability and normal progress, but the period since 1929 has been one of disturbance. The movements of agricultural prices during 1925 and 1929, or at all events during the last three years of that period, were also relatively moderate; the general index numbers for agricultural produce in the existing series were as follows :—

1925	159
1926	151
1927	144
1928	147
1929	144

The advantages of a base period free from wide variations of prices are obvious. These considerations point clearly to the years 1925–29 as the most suitable base for the new index. Other things being equal, it would be preferable to take an average of the whole five years with a view to ensuring that abnormalities in the base due to climatic causes were avoided. Agricultural prices in the last three years of the period were, however, much more stable than in the first two. On the whole it seemed preferable, if the base were to be fixed in this period, to take the average of the three years 1927, 1928 and 1929.

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* See " Index Numbers of Prices Received by Farmers for Farm Products 1910 to 1934, as Revised 1934," issued by the U.S. Dept. of Agriculture, Bureau of Agricultural Economics, Sept. 1934.

There are, of course, other possibilities in favour of which something could be said, but apart from the sacrifice of the advantages that have already been referred to, none of them would be free from objection on other grounds. From some points of view a base period more recent than 1927–29 might be preferred. In particular there is some practical objection to the choice of 1927–29 as base, seeing that prices during that period were at a level to which they do not seem likely to return in the near future, and an index calculated on this period as base may remain well below 100 for some time to come. For example, if the general index number for agricultural produce in the existing series is equated to 100 for 1927–29, the index for 1934, 1935 and 1936 would be 79, 81 and 84, instead of 114, 117 and 122, as at present. There may be a tendency in some quarters to regard the figure of 100 as a sort of datum line that separates prosperity from depression. This aspect of the matter is of particular importance to the agricultural workers' representatives in their discussions on the Statutory Wages Committees. They are obviously in a better position to press for an increase in wage rates if they can show that prices of agricultural produce have increased, and, conversely, their bargaining power is weakened by a decline in the price levels. It may be argued that their position in this respect is safeguarded so long as the index number accurately reflects the changes in price that do occur, whether the number is below 100 or above it. This is true. But bearing in mind, as the workers' representatives on our Committee pointed out, that the representatives of agricultural workers on the Wages Committees are not statisticians, and cannot be expected to understand all the problems dealt with in this paper, it must come to them as something of a shock when a series of index numbers in the 80's is substituted for a series in the 130's which they have been accustomed to quote in 1937. The agricultural workers' representatives on the Committee were bound to point out the unfortunate psychological effect of such a change. On the other hand, it was pointed out to them that a series of index numbers based on pre-War prices as 100 has much more substantial difficulties from the agricultural workers' point of view, seeing that pre-War wages were relatively much lower in relation to agricultural prices than they are to-day. Moreover, from the point of view of bargaining about wage rates, it is frequently more important to compare changes of prices that have taken place since the last change of wage rates, *i.e.*, in the relatively recent past, than to compare changes that have taken place since the base year. Nevertheless, the psychological considerations referred to are substantial.

From this point of view the possibility of retaining the existing base might seem to deserve consideration, though the pre-War base has its own psychological objection to which I have already referred. The retention of the pre-War base might appear to have the advantage of preserving continuity between the new series of index numbers and the old, but, in fact, such continuity would be illusory. If the new index were substituted at a particular point for the old, there would be an awkward and misleading break in the series at that point; the difference between the last index number of the old series and the first of the new would be the result not merely of changes in prices between the two dates, but also of the change in the method of calculation.

After considering the various alternatives, the Committee decided to recommend that the average of the three years 1927, 1928 and 1929 should be adopted as the base.

With a view to meeting the objections that had been raised by the workers' representatives, the Committee considered whether it would be satisfactory to link up the new series with the old. This could have been done, by taking the number of 145 as the number for the new base, 145 being the average of the annual index numbers for 1927–29 in the existing series. This would have given the appearance of continuity, but it would have been misleading, for the reasons I have given. Another objection to this method was that, seeing that sugar beet was not grown in substantial quantities in this country before the passing of the British Sugar (Subsidy) Act of 1925, it would be impossible to incorporate a separate series of index numbers for sugar beet in the new system, which the Ministry wished to do. A new series for sugar beet beginning at 145 for the period 1927–29 would have no meaning except in relation to some figure of 100, which in this case would not exist. This difficulty might have been overcome by taking the figure of 100 for the base for individual commodities; this would, however, have been confusing to the uninitiated; it is preferable that the index numbers for individual commodities and for groups should be related to the same base.

On the whole it was considered that the best method of comparing the new series with the old would be to scale down the old series in the proportion of 145 : 100, and to show these scaled-down figures in italics in a special table.

The Committee, therefore, agreed to recommend that an entirely new series should be calculated beginning with the base period 1927–29 as 100, and that, for the convenience of those who wish to compare the new series with the old, a separate table should be published showing in italics the old series from 1911 to 1913 to the present time scaled down proportionately to the new series.

Weighting. I now come to the question of weighting, which is the principal factor that has led to the need for revision. If the definition of the purpose of the general index number for agricultural produce that I have already given is accepted, then the function of the weighting of the index is to determine the composition of the collection of goods whose aggregate value at different price levels is to be compared. This collection of goods will represent the estimated annual agricultural output of some appropriate year, or average of years. Figures of the composition of the annual agricultural output are available from the results of the agricultural censuses of 1925 and of 1930–31, and from estimates relating to intercensal years prepared on the basis of those results. More recently it has been decided to obtain each year one-fifth of the total information that was formerly intended to be secured by a separate census every five years. As the new information is obtained each year, it is incorporated in the data for the estimation of the annual agricultural output. By this means the data are kept more up to date than under the old method, owing to the difference between the two methods and to the fact that the results of each enquiry can by the new method be made available more quickly. In addition to the information obtained by this means, the Ministry also collects annual statistics of acreages under the various crops and of the numbers of livestock. All this information, together with the statistics of prices collected by the Ministry throughout the year, is used for the purpose of estimating the composition and value of the annual agricultural output.

The problem involved in the choice of weights arises from the fact, which I have already mentioned, that for the measurement of the change in price level between any two dates, either of two different systems of weighting can be used if the necessary information is available, viz. weights corresponding to the collection of goods appropriate to the first date, or weights corresponding to the collection of goods appropriate to the second date. Both weights have equal claims to theoretical validity. But if there has been a considerable change in the collection of goods between the first date and the second, the two systems of weights will cause different results, If, for the purpose of measuring the price movement of the whole agricultural output between two years, the first year's quantitative output is re-valued at the prices of the second year, and the value thus obtained for the second year is divided by the actual value of the output of the first year, the resulting ratio shows how farmers' receipts in the second year would have compared with those in the first year if the agricultural output had remained physically unchanged. Actually, however, if the two years are widely separated, it seems probable that the farmers' receipts would be greater than this comparison indicates; for the physical output in question was produced in the first year, and in so far as farmers adapt their output to the prevailing price conditions, it may be presumed to have been better suited to the price conditions of the first year than to those of the second. Unless the relative price movements of different products between the two years have been identical,* the relative profitability of the different products will have changed, and farmers will have, to some extent, substituted the more profitable product for the less profitable product. Consequently, their receipts in the second year, if nothing has altered except prices, will have been greater than is indicated by the ratio under consideration. But this ratio multiplied by 100 is, of course, the price index given by using the first year's output for weighting. Similarly, if the second year's output is used, the resulting index number shows what the ratio of receipts would have been if the second year's output had been produced in both years. But this understates the results that could have been achieved in the first year by the choice of an output suited to the prices of that year, and, therefore, makes the ratio too high.

It must not, of course, be assumed that farmers can adapt their output rapidly to relative changes in prices of the different commodities. Their choice of output in any particular year is limited to a considerable extent by the amount of land suitable for the production of a particular crop or the support of a particular branch of livestock husbandry, by the farming practice previously pursued and the disadvantages of making changes in rotations, and by the availability of buildings, implements and other capital and of labour required for the change. Moreover, in so far as they are able to adjust their output, it is their profits, and not their gross output, that they seek to increase, and their profits depend upon costs as well as prices. Finally, the farm output is influenced considerably by the weather. It must not be expected, therefore, that adjustments of output in the second year will correspond exactly with the relative changes in prices between the two years. Nevertheless, if the relative changes in prices are appreciable, and the two years are widely separated, some adjustment on account of the changes in prices must be expected, and it is this adjustment that is referred to here.

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* If all relative price movements were identical, there would, of course, be only one possible index number; whatever weighting were used the result would be the same.

It thus appears that, if there is a single answer to the question : " What has been the influence of price changes on the value of the output between the two years? ", the answer must lie between the limits indicated by the two measurements, and if a single measure is required, it seems reasonable to combine the two index numbers to get it. This is what the Irving Fisher index does. The Irving Fisher index, or " ideal " index, as he calls it, is the geometric mean of the two limits. I am not at all sure that in the abstract the geometric mean is any better than any other form of average for the purpose, but it has certain mathematical conveniences. For example, an " ideal " price index and an " ideal " quantity index when multiplied together give an index of value, which is what the layman would expect from the multiplication of a price index and a quantity index. This result will not be obtained if the price index and the quantity index are calculated in the ordinary way, each weighted for the same year, or when they are calculated on the arithmetic average of the two limits. It was properties such as these and others, determined by a large number of arithmetical tests, that led Fisher to advocate his method, though the more relevant argument for it appears to be the one I have indicated. An argument similar to this is used by Pigou in discussing methods of measuring changes in the National Dividend in Part V of the 1920 edition of the *Economics of Welfare*. Here Pigou also suggests the geometric mean as the most appropriate choice of measure between two limits, though he does so on grounds of simplicity and convenience on the whole, and points out that the choice must be more or less arbitrary. Fisher recognized also as an approximation to the " ideal " an index using weights found by adding (or averaging) the quantities for the two years. If all that is required is a comparison of prices between two years widely separated, some such method as Fisher's would appear to be appropriate.

In the present instance, however, the problem is to compare not two years, but a series of years; the collection of goods should, therefore, as far as possible be representative of the whole period. This is difficult enough when the whole period lies in the past; when the period lies partly in the future, and the length of that future period as well as the changes in the actual collection of goods that will take place in it are both unknown, it is impossible to choose a fixed collection of goods that can be regarded as representative.

Moreover, if a fixed collection of goods is adopted now and the actual output of the agricultural industry continues to change, the weighting will become less and less representative of contemporary output as time goes on, and the problem of a further revision of the index number will again present itself some time in the future. This further revision, if dealt with by the adoption of another collection of fixed weights, will necessitate a further break in the series. Such periodical revisions, with consequent breaking of series, are obviously undesirable. They make it impossible to draw comparisons between prices over a long period without making further calculations. They also make it impossible to draw comparisons between prices towards the end of one series and at the beginning of another unless the two series are made to overlap. Overlapping involves two different sets of figures purporting to represent the same prices: this is confusing to all but the student and the expert, who alone understand the reason for it, and it is embarrassing to those representatives of the agricultural industry, whether of employers or workers, who use the index number in economic discussions. In the case of individual commodities, which as a matter of convenience should be represented by a series that has the same base as the general index, the breaking of a series complicates the comparison of prices over a long period, whereas with a continuous series the comparison can be made readily and accurately; the difficulty of making an accurate comparison of the general agricultural price level over a long period due to changes in the agricultural output does not, of course, arise in the case of index numbers of individual commodities unless there has been a considerable change in the average quality of the commodity over the period.

Is it, then, possible to adopt a system that would enable the series to run on indefinitely without becoming increasingly divorced from the contemporary output of agriculture?

It is clear that no system of weighting will make it possible to produce a series of index numbers of agricultural produce as a whole that will accurately represent price changes that have taken place over a long period of time, if considerable changes in the nature of the total agricultural output have taken place during that time. But a breaking of the series renders it impossible to make any comparison at all over a long period without further calculation. Moreover, while it is desirable that the possibility of long-period comparisons should be preserved in spite of their imperfections, comparisons between recent periods are more important for practical purposes. The solution of the problem, therefore, appears to be one that will enable short-period comparisons to be accurately made and will, at the same time, permit of some comparison over a long period, *i.e.*, will enable the series to be continued indefinitely. For comparisons between present-day prices and those of the recent past, the most up-to-date weighting should obviously be used. To enable comparisons in the recent past to be made in a series that runs on indefinitely, the weighting should be kept up to date. This can be done by a system of moving weights under which the weighting is changed periodically to correspond with the change in the actual agricultural output. The agricultural output of a particular year may, of course, be influenced by weather conditions as well as by the trend of agricultural practice due to the general economic situation in the industry. It will be desirable that the weights should reflect the trend rather than the annual changes that are due to purely weather conditions; this could be done by weighting the index number for any particular year in accordance with the average output for the latest previous five years for which information is available. For example, the index number for 1937 would be obtained by using weights derived from the average annual output of the five years ending 1935–36. Weighting would thus change each year, the latest year's output being added and the earliest year's output being dropped. For the purpose of calculating the index number for each year, the output chosen for that year would be valued at the prices of that year and of the base year; the index number would represent the ratio between the two values.* Under such a system, however long the series were continued, it would be possible throughout the series to make accurate comparison between prices in years not very

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* In practice the necessary weights would be obtained by valuing the quantities of the constituents of the appropriate output at the prices of the base year; the index number for each commodity in the given year would be multiplied by its appropriate weight; the weighted index numbers would then be added together; and the result would be divided by the sum of the weights. For example:

If p_o = price of a commodity in base year.
If p_n = price of the commodity in given year.
If q = quantity of the output of the commodity in the five-yearly period used for weighting.

Then the index number for the commodity in given year is $\frac{p_n \times 100}{p_o}$.

The weight for the commodity, *i.e.*, the quantity of the commodity in the output of the five-yearly period valued at the price of the base period, is $q \cdot p_o$.

$$\text{Then weight} \times \text{index number of commodity} = q \cdot p_o \times \frac{p_n}{p_o} \times 100 = q \cdot p_n \times 100.$$

The general index number for all the commodities then becomes:

$$100 \times \frac{\Sigma q \cdot p_n}{\Sigma q \cdot p_o}$$

which is the ratio of the output valued at the given year's prices and the output valued at the prices of the base year.

far apart, and as satisfactory a comparison as possible, without making separate calculations, between two years separated by a long period, bearing in mind that in agriculture the changes in the composition of the total output are gradual.

The Committee gave much consideration to this suggestion. It was realized that although this system would give a satisfactory comparison with the base period and over short periods, a comparison over long periods at some other part of the series would be less accurate if there had been a considerable change in the composition of the output or in the price of any particular commodity. There would appear to be no system, however, that would in such circumstances give equally satisfactory comparisons between any two points in a series covering a long period of years. As I have said, comparisons between recent years are the most important, and for this purpose the system of moving weights gives the best results in a long series.

Having regard to the purpose of the agricultural price index and to the undesirability of making frequent changes of series, the Committee decided to recommend that the system of moving weights based on the average annual output of the latest five years should be adopted.

The Committee also recommended that the Ministry should consider from time to time, and at least once in every ten years, whether there had been any change in the agricultural output of a permanent nature and of such an extent as to make it desirable to adopt a more recent period than 1927–29 as base.

For the purpose of their consideration of the question of moving weights, the Committee were supplied with a table showing weights based on five-yearly moving averages over the last 8 years. This table is reproduced in Appendix I. The weights shown are based on the actual prices used for the old index number. The weights used in the new series may be slightly different in some cases owing to the changes made in price quotations, and owing to the inclusion of additional commodities such as sugar beet and glasshouse produce. The table is, however, sufficient to show that the changes in weighting under the system of five-yearly moving averages will be slow. It will be seen that, with the exception of eggs, the weight of which changes from 5 per cent. in 1925–29 to 8 per cent. in 1932–36, there is no change over this period of more than 1 per cent. in the weight of any commodity; nor in the case of eggs is the change between any two consecutive years more than 1 per cent. of the total.

The consideration of this table led to the question whether it would be preferable to calculate the percentage weights of individual commodities to the first decimal place instead of to the nearest whole number. This would lead to more frequent changes in the weights of individual commodities, but it would probably be over-sensitive, and would imply a degree of accuracy that would not be justified by the available data. The Committee recommended, however, that, while the weights should be calculated to the nearest whole number, they should be related to a total of 200 instead of 100; in other words, that the individual weights should be calculated to the nearest half of 1 per cent. of the total. The Committee also recommended that the general index number for agricultural produce as a whole should be calculated to the nearest half, but that the numbers for individual commodities should continue to be given to the nearest unit.

The Monthly Index. With regard to the monthly index of prices of agricultural produce, I have already explained that, in order to eliminate the effects of normal seasonal variations, the base prices used in the calculation of the monthly index are the average prices of the different products for each of the corresponding months during 1911–13, and not, as in the case of the annual indices, the average for the whole of the base period. This method of calculation has, as I have said, been found in practice to be defective to some extent.

The monthly index is designed to show the trend of prices, and not their actual monthly movement. But while this is useful for certain purposes, it may give rise to mistaken inferences unless the nature of the index is properly understood. A rise in the index for a particular month may mean not that prices are actually higher during that month than in preceding months, but that they did not show their usual seasonal fall. In such a case the lack of a second index, which shows the actual movement of prices, is an obvious inconvenience, and explanations have to be published in order to prevent misconceptions.

Such an explanation had recently to be given in connection with the index number for milk. In 1911–13 the wholesale price of milk rose sharply between summer and winter, September being reckoned as a summer month and October as a winter month. In 1937 the rise from summer to winter prices took place in two stages: a rise of *2d.* per gallon in September was followed by a further rise of *2d.* in October. The result was that the index number of liquid milk prices rose from 175 in August to 202 in September, and fell back to 171 in October. Since, for the purpose of the general index, milk has a weight of 21 out of a total of 123 for all the agricultural commodities in the existing series, the rise in the milk price index in September represented an increase of about 5 points in the general index, while the subsequent fall in October represented a corresponding decline. The general index actually rose and fell by 4 and 6 points respectively in these two months.

Liquid milk presents the most serious difficulty in this connection. Owing to the fact that the difference between summer and winter prices is considerable, and the actual date of the change is not dependent wholly on seasonal causes, but upon the nature of the agreement made between the representatives of producers and distributors, there is no method of evening out seasonal variations that would overcome the difficulty referred to.

The seasonal prices of fat cattle have also been abnormal in recent years. Before 1932 prices followed a well-defined seasonal movement, rising from January to June and then falling steadily to a low level in October and November, from which there was a sharp recovery in the first half of December for the Christmas trade. In 1933 and 1934 these seasonal movements were almost wiped out, and in the first quarter of 1935 the movement was also abnormal. Since the spring of 1935 there has been some return to what have been considered to be the more normal conditions, and in 1937 the price movements have been more in conformity with what were formerly regarded as the usual seasonal movements. Here again it would have been impossible by any means to correct the prices for seasonal variation, seeing that seasonal variation in the years in question was abnormal. Verbal explanation appears to be the only method of dealing with aberrations of this kind, and the subject was dealt with in this way in the Ministry's Report on Agricultural Statistics, Part II, for 1934.

Apart from the exceptional cases of milk and fat cattle, experience has shown that the present method of calculating the monthly index number does not entirely remove the effect of seasonal variation in the prices. It appears that regular movements of the index occur between certain months, which have to be allowed for if seasonal variation is to be entirely removed. The index number normally falls from September to October, and rises from December to January. This movement has been tested for the period 1925–36 by calculating a series of moving averages of the monthly series and comparing this series with the published series. The comparison indicates that during this period the September indices were, on the average, 1·5 per cent. too high and the October indices 1·6 per cent. too low; and that the December indices were 1·6 per cent. too low and the January indices 4·7 per cent. too high.

These difficulties diminish the value of the present monthly index number. Owing to the monthly change of base, the monthly index cannot be said to show the actual monthly movement of prices, and owing to the failure effectively to eliminate seasonal movements, it does not accurately show the trend of prices. The only satisfactory comparison that it provides is between the same months in different years, but this comparison would, of course, be shown equally well by an index that made no attempt to remove seasonal variations.

Nevertheless, a monthly index number corrected for seasonal variations is useful, and it seems desirable to change the existing method rather than to abolish the seasonally corrected index number altogether. The weaknesses in the present method may be due to three causes: the three-year base period is probably too short to make adequate allowance for normal seasonal variations; the base prices may have been affected by the upward trend of prices between 1911 and 1913; and seasonal movements may have altered since 1911–13.

The Committee recommended that in future two series of monthly index numbers should be published, one showing the actual changes in prices from month to month, and the other corrected for seasonal variation.

The numbers in the first series have been obtained by comparing the monthly price of the commodity with the annual average price in the base period 1927–29. The numbers in the second series have been obtained by the use of moving averages. For the initial period 1927 to date the index of seasonal variation that has been applied has been calculated from centred monthly moving averages over the ten-year period 1927–36. Just as fixed weights for the general index number may become out of date owing to changes in the composition of the agricultural output, so it is possible that some change in seasonal variation of prices may occur in the future in regard to some commodities. To make allowance for any such changes a moving index of seasonal variation will be used by making the ten-year period a moving one. This will be done by annually deleting the first year of the ten-year period and adding the latest year.

Each commodity has been tested for seasonality in the manner described, and corrections have been made where there was a marked seasonal swing. Where no such movement was apparent, or where the variation was only slight, no correction has been made to the ordinary index; the Ministry will, of course, continue to test each of these commodities, and if a seasonal variation appears in any of them over a period of a few years, a correction for seasonal variation for that commodity will be introduced.

Appendix II shows how an index of seasonal variation for prices of eggs has been calculated in the manner described; it will be seen that Table III shows a definite seasonal movement of prices.

These two series of monthly index numbers will be calculated for agricultural produce as a whole as well as for individual commodities, with the exception of fat lambs, fruit, vegetables, glasshouse produce, hops and sugar beet, for which continuous monthly prices are not available. The basis of weighting will be the same for the monthly as for the annual series, except that the weights for the monthly series will be adjusted as a result of the exclusion of certain commodities from the monthly index that are included in the annual index. It would, of course, be desirable, if it were possible, to have for the monthly series monthly weights that were in accordance with the monthly output of agricultural produce. Unfortunately, there is no information of monthly output on which monthly weights could be based. The correction for seasonal variation will, however, be somewhat similar to the use of changing monthly weights. Supplementary to these two monthly series verbal explanations of any abnormal movements will be published.

Commodities to be Included and Quotations to be Used. It will be possible in the revised index both to enlarge the range of commodities included and to improve, in certain instances, the quotations on which individual indices are based. The additional items to be included are fat cows, fat lambs, sugar beet, and glasshouse produce. Sugar beet is an important new crop. The importance of glasshouse produce has increased in recent years, and useful data on the present-day output have recently been obtained by the Ministry by a special census. On the other hand, the output of field peas is now insignificant, and there is no reason for their inclusion.

A good deal of consideration has been given to the reliability of the quotations used, with the object of securing figures that will be as representative as possible of the prices received by farmers; these are not always the same as the market prices, owing to the cost of transport of the produce to the market and to such charges as sales commission. Owing to the wide variation in these costs and to the absence of data, it would not be possible to make any allowance for them, and it is necessary in most cases to continue to use wholesale market prices, and, where possible, those recorded in producers' markets.

Where price quotations of different qualities are received, the practice in the past has been to use the price of second-quality produce for the purpose of the index numbers. The Committee considered that an average of first and second quality would be preferable in the new series, and they made a recommendation that this average should be used wherever possible. They also recommended that where an average price had to be calculated, a weighted average rather than a simple average should be used where possible, though it was agreed that in the case of fat cattle, for the reason I have already mentioned, a simple average of first and second quality would be sufficient.

The price quotation in the old series that is now most open to question relates to one of the most important commodities in the agricultural output, viz. milk. Owing to recent events, it would have been necessary to make a change in regard to the price quotation for milk, even if the index numbers had been in all other respects satisfactory. The difficulty has arisen as a result of certain influences both before and since the establishment of the Milk Marketing Board, which have led milk producers to sell a greater proportion of their milk in the liquid form, whether for liquid consumption or for manufacture, and a smaller proportion in the form of butter and cheese made on the farm. The price of milk sold for liquid consumption is very much higher than that sold for manufacture into milk products —mainly butter, cheese, condensed milk and cream. Under the Milk Marketing Scheme the country is divided into regions, and in each region the receipts from the sales of the milk produced in that region are pooled, with the object of securing a price to the producer, called the regional pool price, that is the same whether his milk is sold for manufacture or for consumption in the liquid form. The system is somewhat complicated by certain adjustments that are made to prevent undue differences between the regional pool prices, by the deduction of various transport charges, and by the granting of certain premiums to individual farmers for level deliveries throughout the year and for producing milk up to a certain standard of quality. But these complications need not concern us here. It is sufficient to draw the broad distinction between the regional pool price, which every farmer in the region receives, and the contract price, which is the price at which the Milk Marketing Board contracts to sell milk to distributors for consumption in the liquid state.

Before the establishment of the Milk Marketing Board in 1933, the Ministry's index number for milk was based on estimates of average monthly prices paid for milk delivered on contract to three cities, viz. London (divided into east and west), Birmingham and Manchester. The estimates were made by reporters appointed by the Ministry, and they included milk sold under the agreed terms negotiated by what was known as the Permanent Joint Milk Committee, a body representative of producers and distributors, and also under contracts not made under that agreement. In each case the estimate related normally to milk sold for liquid consumption, and the price was that paid by the wholesaler or distributor, and therefore included all expenses paid by the producers in delivering the milk to the city. To obtain prices for the monthly index number, a straight average of the four estimated prices from the three cities was taken and compared with the average for the corresponding month in the base period (1911–13). Monthly prices were averaged in order to calculate the annual index number.

After the establishment of the Milk Marketing Board it became possible to secure much more accurate information relating to the prices received by milk producers than had previously been obtained. The Board arranges the contract terms for the sale of milk by the producers, receives the money, pools the receipts and pays each individual farmer included in the Scheme the regional pool price, subject to the appropriate deductions for transport and the appropriate premiums. It was obviously desirable to take advantage of the accurate statistics made available by this system, and the Ministry decided to do so. But in order to preserve continuity with previous quotations, which were for liquid consumption, it appeared desirable to adopt the contract price, and not the pool price, in order to show the effect of price changes. With the rapid increase since the establishment of the Board in the quantity of milk sold by the producers for the manufacture of milk products,* the price used for the index number has become less and less representative of the price actually received by producers for their milk. The Committee agreed that in the new series the pool prices should be used. Of course, pool prices are only available since October 1933, when the Board was established, and it has been necessary to make estimates of prices that can be regarded as comparable for the earlier years. I have thought it necessary to deal in some detail with this difficult question of milk prices because of the importance of milk in the agricultural output, and because it illustrates some of the difficulties with which we have to contend.

Fertilizers and Feeding-stuffs. The Committee agreed to recommend that the index numbers for fertilizers and feeding-stuffs should be dealt with on the same lines as the index numbers for agricultural produce, *i.e.*, that the base period should be changed to 1927–29, and that the group indices should be determined by the use of moving weights based on the most recent information concerning the purchase of these commodities by farmers.

Conclusion. In general, the Committee recommended that full information concerning the new series of index numbers should be published when the series was instituted, and that the weights on which the general indices were based should be published annually. It was agreed that it would be desirable to publish a separate booklet explaining in simple language how the index numbers were computed and giving tables in the appendix that would show how the new index compared with the old. This booklet will, of course, merely describe the new methods; it will not give the reasons for the adoption of these methods. This I have attempted to do in this paper, and I should like to express my gratitude and that of the Ministry for the opportunity that the Society has afforded for a discussion of this subject, and for placing on record for the benefit of statisticians and others interested in the agricultural index numbers certain aspects of the subject that would not otherwise has been made available to them.

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* In recent months this movement has been reversed; there has been a decline in the quantity of milk sold for manufacture and an increase in the quantity sold for liquid consumption.

APPENDIX I

Five-Yearly Moving Weights expressed as Percentages

1925–29 to 1932–36

Commodity	1925–29	1926–30	1927–31	1928–32	1929–33	1930–34	1931–35	1932–36
Wheat	4	4	4	3	3	3	3	3
Barley	3	3	3	3	2	2	2	2
Oats	1	1	1	1	1	1	1	1
Beans	—	—	—	—	—	—	—	—
Cattle (Fat) ...	14	14	14	14	13	13	13	13
Sheep (Fat) ...	8	8	8	8	8	8	8	8
Pigs (Fat):								
Baconers ...	5	4	4	4	5	5	5	5
Porkers	6	6	6	6	6	6	6	6
Milk	25	25	25	26	26	26	26	26
Butter	3	3	3	3	3	3	3	3
Cheese	1	1	1	1	1	1	1	1
Poultry	2	2	2	2	2	3	3	3
Eggs	5	6	6	7	8	8	8	8
Potatoes	7	7	7	6	6	6	6	6
Hay	3	3	3	3	3	2	2	2
Fruit	4	4	4	4	4	4	4	4
Vegetables	5	5	5	5	5	6	6	6
Wool	3	3	3	3	3	2	2	2
Hops	1	1	1	1	1	1	1	1
Total ...	100	100	100	100	100	100	100	100

APPENDIX II

Method of Calculating an Index of Seasonal Variation for Prices of Eggs

Table I below shows the actual average monthly prices of eggs for each month in the years 1927–36. Table II shows for each month the centred twelve-month moving average price calculated from the prices in Table I. The method of calculating the figures in Table II is as follows:—

For example, take the calculation of the figure for July 1927.

In the first instance the average of the prices, January 1927 to December 1927, in Table I is struck.

Average price January 1927 December 1927 = 17*s*. 7*d*. . . .(1).

Seeing that each monthly average price in Table I will usually represent the price prevailing at about the *middle* of the month, the average of the prices for January to December will be centred at the *end* of June.

Similarly the average of the prices February 1927 to January 1928 will be centred at the *end* of July.

Average price February 1927–January 1928 = 17*s*. 11*d*. . . . .(2)

In order that the twelve-monthly average may be centred at the middle of July, and thus be comparable with the price at the middle of July, the average price adopted for Table II is the average of (1) and (2).

$$\text{Average of (1) and (2)} = \frac{17s.\ 7d. + 17s.\ 11d.}{2} = 17s.\ 9d.$$

The figure for July 1927 in Table III is the price for July in Table I, expressed as a percentage of the figure for July in Table II., viz :—

$$\frac{13s.\ 8d.}{17s.\ 9d.} \times 100 = 77{\cdot}0.$$

The figure for July in Col. 11 of Table III is the average of the figures for July in Cols. 1–9.

For the purposes of convenience in applying the index of seasonal variation to any monthly index number of actual prices of eggs, the averages in Col. 11 have in Col. 12 been adjusted to make their average equal to 100. For example, the index number of prices of eggs for July 1936 is adjusted for seasonal variation as follows :—

The index number of actual variation of price for July 1936 is 70.

Then the index number adjusted for seasonal variation is $\frac{70}{84{\cdot}7} \times 100 = 83$.

TABLE I

Average Monthly Prices per 120 *of Eggs* 1927 *to* 1936

Month	1927		1928		1929		1930		1931		1932		1933		1934		1935		1936	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
January ...	19	8	23	10	21	0	18	10	16	7	14	6	12	8	13	1	12	11	15	5
February	19	4	16	2	20	0	18	0	11	1	12	3	13	11	11	5	11	7	14	2
March ...	12	3	11	3	17	0	11	8	10	11	9	4	9	1	8	0	8	5	9	7
April ...	11	0	11	0	11	8	11	2	9	4	8	8	7	7	7	11	7	8	8	6
May ...	10	11	11	7	12	11	10	11	9	3	8	4	8	0	7	8	8	6	9	6
June ...	12	1	12	7	12	11	11	9	9	6	9	6	9	6	9	3	9	11	10	6
July ...	13	8	13	11	16	2	14	9	12	2	11	10	10	10	10	1	11	9	12	8
August ...	16	8	17	11	18	5	16	2	13	8	13	3	13	4	13	10	15	2	15	1
September	19	4	19	2	19	7	17	0	15	1	15	6	14	8	13	0	15	0	15	6
October ...	24	6	24	3	26	3	22	8	18	9	17	10	16	7	16	9	17	3	20	5
November	27	3	27	11	28	5	24	7	22	7	20	8	20	2	20	5	20	5	20	6
December	21	8	24	3	25	10	20	1	16	5	16	2	17	5	17	1	19	4	18	10

TABLE II

12-*Month Centred Moving Averages of Egg Prices* (*per* 120) 1927 *to* 1936

Month	1927		1928		1929		1930		1931		1932		1933		1934		1935		1936	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
January ...	—		17	8	18	8	18	0	15	3	13	5	12	11	12	6	12	7	13	11
February	—		17	9	18	9	17	10	15	1	13	4	12	11	12	6	12	8	13	11
March ...	—		17	10	18	10	17	8	14	11	13	1	12	10	12	5	12	10	13	11
April ...	—		17	10	18	11	17	5	14	8	13	1	12	9	12	4	12	11	14	1
May ...	—		17	10	19	0	17	1	14	5	13	3	12	8	12	5	13	0	14	3
June ...	—		17	10	19	1	16	8	14	2	13	2	12	9	12	4	13	1	14	3
July ...	17	9	17	8	19	1	16	4	13	11	13	1	12	10	12	4	13	3	—	
August ...	17	9	17	9	18	11	16	1	13	9	13	1	12	9	12	1	13	5	—	
September	17	7	18	2	18	7	15	11	13	7	13	1	12	7	12	1	13	7	—	
October ...	17	7	18	5	18	4	15	10	13	6	13	0	12	7	12	5	13	8	—	
November	17	7	18	6	18	3	15	8	13	5	13	0	12	7	12	5	13	9	—	
December	17	8	18	7	18	1	15	6	13	5	13	0	12	6	12	5	13	10	—	

TABLE III

(i) Percentage Relation of Actual Egg Prices to 12-month Moving Averages and (ii) Seasonal Indices derived therefrom

Month	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	Seasonal Indices	
											Average 1927–36 (Cols (1) to (9) or (2) to (10))	Figures in Col (11) adjusted to make their average equal to 100
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
January	—	134·9	112·5	104·6	108·7	108·1	98·1	104·7	102·6	110·8	109·4	109·3
February	—	91·1	106·7	100·9	93·4	91·9	107·7	91·3	91·4	101·8	97·4	97·3
March	—	63·1	90·3	66·0	73·2	70·0	70·8	64·4	65·6	68·9	70·3	70·2
April	—	61·7	61·7	64·1	63·6	65·0	59·5	64·2	59·4	60·4	62·2	62·1
May	—	65·0	68·0	63·9	64·2	62·9	63·2	61·7	65·4	66·7	64·6	64·5
June	—	70·6	67·7	70·5	67·1	72·2	74·5	75·0	75·8	73·7	71·9	71·8
July	77·0	78·8	84·7	90·3	87·4	90·4	84·4	81·8	88·7	—	84·8	84·7
August	93·9	100·9	97·4	100·5	99·4	101·3	104·6	112·2	113·0	—	102·6	102·5
September	110·0	105·5	105·4	106·8	111·0	118·5	116·6	105·4	110·4	—	110·0	109·9
October	139·3	131·7	143·2	143·2	138·9	137·2	131·8	134·9	126·2	—	136·3	136·2
November	155·0	150·9	155·7	156·9	168·3	159·0	160·3	164·4	148·5	—	157·7	157·6
December	139·6	130·5	142·9	129·6	122·4	124·4	139·3	137·6	139·8	—	134·0	133·9
Average ...	—	—	—	—	—	—	—	—	—	—	100·1	100·0

DISCUSSION ON MR. HOUGHTON'S PAPER

MR. HAROLD VIGOR: It is with great pleasure that I rise to propose that a hearty vote of thanks be accorded by the Society to Mr. Houghton for the paper which he has just read to us. Mr. Houghton has for some years been in charge of the Statistical Division of the Ministry of Agriculture, and in reading this paper before the Society he has renewed a relationship between the Statistical Division of the Department and the Society which was much closer in former years than it has been of recent date. The records of our Society show that in times past the distinguished officials in charge of the statistical work of the Ministry, or its predecessor, the Board of Agriculture, have taken an active part in the business of the Society and have frequently contributed at our meetings. Major Craigie and Sir Henry Rew occupied the office of President and rendered many services to the Society. We also recall with pleasure the important work, published in the *Journal*, of Mr. R. H. Hooker and Mr. R. J. Thompson, the latter of whom we are glad to see here to-night. It is a happy occasion, therefore, that the old contacts between the Ministry and the Society are renewed to-night in such an excellent paper. I trust we may look forward to receiving frequent contributions from the gentlemen at the Ministry who are in charge of the Departments of Agricultural Statistics and Economics.

May I in passing express the opinion that the agricultural statistics of the United Kingdom, which have been collected in increasing volume since 1866, are a quarry of rich material with which it should be possible to produce statistical work of great value? It is a quarry which has been only partly worked, and since agriculture now occupies a greater place in public discussions than it has done for several generations, every effort should be made to extract from this quarry the full measure of the varied information which lies at hand. Important results could be obtained if statistical research were undertaken by the Ministry itself with only a small amount of the expenditure which is devoted to other fields of agricultural research.

Mr. Houghton is to be congratulated upon the lucid manner in which he has presented the subject of his paper. The statement of the case and the manner proposed for the review are so clear that there is little room left for questions or criticism. I do not myself propose to criticize, because there are people here around me with much higher qualifications for such a task.

It is time that an index number, based upon the output of 1913, should be revised, especially as it plays a part of some importance in the wages of agricultural workers. I think we ought to congratulate the Committee that has advised the Minister, upon the speed with which they have tackled their task and reached their conclusions.

One of the subjects which engaged a great deal of attention was the question of weights, and the Ministry has decided to have a moving five-year average for the weighting system. Appendix I shows how this system will work, and that over a period of ten or eleven years there is very little change. Such changes as do occur can obviously have no appreciable effect upon the general index of prices, and one wonders whether it is not possible to exaggerate the importance of the system of weighting. I remember a high statistical authority saying that when you have to form an index number combined with a large number of articles, very fine precision in weighting is not of much importance so long as the weights generally are fairly reasonable. No doubt Mr. Houghton's Committee went into matters of this sort, and we shall be interested to see, when the Ministry publishes the leaflet to which he refers, what is the difference between the index numbers calculated on the old and the new bases.

I think it will occur to a good many people that an index number of agricultural prices as a whole is not, in fact, representative of anything typical in the farming industry: I mean that there is probably no farm in the country which produces all the various commodities grouped in the agricultural price index number. Farming is so specialized that the index number cannot be said to represent an average farm: no one knows of such a farm. I wonder, therefore, whether it would be possible for the Ministry to supplement the index number of agricultural prices as a whole by subsidiary index numbers which represent typical English farms? In Part I of the Agricultural Statistics for 1932 the Ministry has classified agricultural holdings in England and Wales in 1930 and 1924 according to the type of farming pursued; the holdings are shown as consisting mainly of arable land, or pasture land, mixed holdings, small holdings, fruit and vegetable holdings and so on; and the Report shows the distribution of crops and livestock on each class of holding. It may be worth while to attempt to compile subsidiary index numbers to show the price level in respect of the more important types of agriculture represented by the different types of holding. If this could be contrived, the figures would be of some value as showing how different types of farming tend to be affected by price changes, more accurately than one can judge from the general index number of agricultural prices.

There is one point about which I think we ought all to be on our guard in using an index number of agricultural prices. In the very system of weighting that has been adopted, the figures for 1937 are weighted by the average output of 1932–36. The index number, therefore, simply indicates the average price at which the output is sold; but as the index number takes no account of the quantity of the various products produced in the year 1937, it clearly does not purport to be an index number of the value of the output of the year 1937.

I am perhaps going a little bit beyond the scope of this paper, but I see, in the methods which are being pursued by the Ministry to revise this index number, perhaps an anticipation of development in the future. I hope that the statistical brains in the Ministry may be directed to develop the index-number idea in relation to agricultural statistics. We know very well that the index number of the average price of products is not an index number of the profitableness of farming: the fact that the Ministry finds it necessary to publish index numbers of prices of fertilizers and feeding-stuffs is an admission of this fact. We sometimes lose sight of the fact in public discussion that the turning over of agricultural land from arable to grass farming, from crop production to livestock production, has also involved a big expansion in the purchase of agricultural feeding-stuffs imported from abroad. I have never seen a computation published of the extent of the growing dependence in agriculture upon raw materials imported from abroad and the effect of that dependence upon the net output of agriculture. I think the Ministry might well give some consideration to this aspect of the output question with a view to ascertaining whether it would not be possible to prepare something like an index number of the net output of the agriculture of the United Kingdom. The suggestions I have made may present difficulties in solution, but they are well worth the attempt.

I have great pleasure in moving a vote of thanks to Mr. Houghton for his excellent paper.

DR. WISHART: I second the vote of thanks to Mr. Houghton with great pleasure. Mr. Houghton is too modest to tell us straight off what part he took in doing this work; the facts, however, that he was the Chairman of the Committee and that he is presenting the paper, make it not a bad guess that a very great part of the inspiration towards this reform, and of the driving power necessary for carrying it out, are due to Mr. Houghton himself. Both he and the Ministry are to be congratulated on a very desirable reform, and a very useful piece of work.

No doubt Fellows have noted the statement made that seven out of the twelve members of the Committee were Fellows of this Society, and the Society may also take pleasure in the fact that it has provided the platform from which the new scheme has made its bow to the public and, through publication in the *Journal*, will provide the scientific and general public with information relating to the new index scheme.

In a conversation concerning this meeting with a friend who is an expert in agricultural economics, but who was unaware of the purport of the paper, he said, "Be sure and criticize the weights, which have not been revised since 1908." That particular avenue of criticism is closed to me, since one of the main points in the paper is that revision of the weights is necessary. I regard this as one of the cardinal points of the whole system.

Quite apart from the use of Table I on p. 277 for facilitating the revision of the weights, the table itself is an eloquent testimony to the change that has come over farming practice since those years preceding the War. I note that the output of 1935–36 adds up to 100 per cent., and of course that is so because you are comparing the same items of produce as in the earlier period. What is not stated in the paper is the percentage of the whole output that would be represented by a new crop like sugar beet. The introduction of sugar beet is an important change since the pre-War years, and I have been wondering what difference it would make to the weights.

I do not propose to refer to the paper in any detail. The whole argument is closely reasoned, well thought out and easy to follow. To a statistician the discussion on the type of average is of value, and it is interesting to reflect how often the simple arithmetic mean proves to be the appropriate measure to take. The choice of the base period as 1927–29 seems reasonable. The difficulty which most people are likely to experience is precisely that alluded to by the speaker—namely, the change from an index number running well above 100 to one well below, 100 being often considered to be a datum line below which is depression and above which is prosperity. Important problems such as the adjustment of wage-rates, and so on, crop up in this connection, and therefore the idea of going back and revising the old index number by scaling down for comparison with the new, is an exceedingly useful one.

As regards the weights, I do not claim to know much about the theory of index numbers. The concept is not really difficult mathematically, but is one which when taken up in detail for study by the economist generally bristles with difficulties. It appears, however, as if the moving-weight system is the solution of this problem. Here I speak in ignorance, but I frankly do not know how far such a moving-weight system has been adopted by any other official Department. It seems to me to give what is wanted if further breaks in continuity of the series are to be avoided.

I would repeat that I have great pleasure in seconding the vote of thanks.

Mr. R. J. Thompson, speaking as a former colleague of Mr. Houghton, said he was glad to have this opportunity of complimenting him on this successful and well-considered revision of the Ministry's index number. It had been apparent for some time that, owing to the altered conditions of the last seven or eight years, the older index number was not fulfilling very satisfactorily the purpose for which it was devised. The number had become out of date because comparison with pre-War years had ceased to have much practical utility. What people really wanted was a comparison with some period just preceding the recent depression. The adoption of the new base period, 1927–29, completely met this point, and would give in a direct form the information which most persons interested in agriculture desired to have.

In the same way it had become evident in recent years that the weighting was ceasing to correspond with current facts. Mr. Houghton seemed to agree that this was the case. If the movement of the index number were compared with the fluctuations in the annual estimate of the agricultural output, it would be found that between 1925 and 1930 the two fairly corresponded. Since that time the divergence between the two had become quite considerable and it was evident that the index number was not responding to the change in current conditions. The adoption of a weighting based on a five-year moving average would put this right and would probably prevent similar divergences in future.

On p. 299 Mr. Houghton mentioned that the prices received by the farmer were not always the same as market prices, owing to the cost of transport of produce to the market and such charges as sales commission, the suggestion being that market prices were not true farm prices, because the farmer had to incur the cost of transport before he received payment. It would seem, however, that if a farmer has to incur the cost of transport as well as commission on the sale of his product before he receives payment, these charges form part of the necessary cost of production and must be put in the same category as other costs. Production was not completed until the product was actually sold, and the price received had to be put against all the charges involved. In an index number it was not a matter of great importance, because so long as the prices used were the same throughout, the difference was very small. Mr. Thompson mentioned this point because it was suggested in a paper by Dr. Carslaw two years ago that "farm prices" ought to be used rather than "market prices" as representing more exactly what the farmer actually received.

Another satisfactory feature of the revision would be the new series of monthly index numbers which would enable the changes in prices from month to month to be measured, as well as the seasonal variations. That had been needed for a considerable time, as the existing index was apt to be misleading to people who did not precisely understand the way it was made up.

Mr. Vigor had remarked that he was rather doubtful whether the weighting was of very much real importance, and of course it was a point in statistical theory that the weighting might be very considerably varied without producing much change in an index number, but Mr. Thompson felt that in the case of this particular index number the weighting did have a considerable influence. It would be interesting when the new figures were published to see what was the extent of that influence.

He concluded by saying that he thought Mr. Houghton, the Ministry and the Members of the Committee were all to be congratulated on the workmanlike manner in which the problems presented by this somewhat special and peculiar index number had been dealt with.

Mr. J. M. Ramsay said he was a little diffident in speaking, owing to the fact that he had been a member of the Committee, but, coming from Scotland, perhaps he might dissociate himself so far from the main body of the Committee as to congratulate Mr. Houghton on the work he had done as Chairman of that Committee, and for the presentation he had made that evening of the principles and practice of framing the agricultural index number.

The paper had amply justified its presentation to the Society, because it had dealt with three aspects of statistics: first of all what might be called the agricultural technique, or the method of obtaining material for index numbers of agricultural prices; secondly, the statistical technique involved, which, as had been said, led to a good deal of discussion in the course of the Committee's proceedings; and thirdly, the use made of index numbers after they were produced. The psychological aspect had been described in the paper and had been referred to in the discussion, and it was an important point whether there was in the minds of farmers and farm-workers a feeling that the figure 100 represented a condition of normal prosperity in the industry.

Apart from the specific example given in the paper of the use of the index number as one of the elements in the discussion of agricultural wages, perhaps it was not unfair to say that the index number had a political importance as a guide to the prosperity of the agricultural industry. From that point of view it was of some interest that the average index number for 1931–36 was twelve points lower than it would have been if the weighting had been based on the year 1935–36 instead of 1908.

Mr. Ramsay wished to join with other members in thanking Mr. Houghton for what he had done in carrying out an admirable piece of work in the public interest and in the interest of the industry to which Mr. Houghton and he were statistically devoted.

SIR ALFRED FLUX, expressing his great interest in the subject of Mr. Houghton's paper, referred particularly to the difference of aim of the Ministry of Agriculture in recording the average money value per unit of the different products of agriculture, and of the Board of Trade in seeking, for use in the compilation of its index number, prices that would represent goods of the same quality and type at different times of quoting. Mr. Houghton had laid special emphasis on the fact that this aim of the Board of Trade was not only an object sought by his Ministry, but that it was quite clearly recognized that the quality of some products included in the Ministry's compilations was different at different seasons. In spite of such variations, the Board had, as a matter of course, used the official prices of the Ministry.

Mr. Houghton had referred to the intention to make the survey of agricultural output in five spasms, and Sir Alfred expressed some curiosity as to the basis of the sub-division into five parts. The paper showed that food, including milk and cattle, made up 39 per cent. of the total output. The division of output into five parts of even roughly equal importance, for investigation in different years, appeared to be by no means an easy problem. If the basis of division were geographical, the difficulty was not readily avoided. He put forward the question whether the five-part division was to be regional or industrial. It was of no small importance that people should be helped to understand what was being done, and to appreciate the significance of the new figures to be prepared by the Ministry for issue to the public, which were to keep that public in touch with the facts of the present time, or as near to the present time as might be practicable.

The risk of change in the elements out of which the index numbers of prices were built up was very great in the fields covered both by the Ministry of Agriculture and by the Board of Trade. The latter Department, determining not to publish figures that might be deceptive in regard to current events, had adopted a procedure that would have been deemed strange not long since. That procedure was to start a new series of index figures each fifth year. He had been rather impressed by the apparent reluctance of the Ministry to move frankly and freely along the road chosen by the Board. He expressed a hope that, if not by modifying the construction of the main indices, then by some other means, such as the issue of supplementary information, careful students might be enabled to trace the effect of changing circumstances on the indications of indices prepared on a fixed formula. It was necessary to think, not only of keeping a contented farming population, but of enabling those responsible for policy to have, correctly worked out for them, the details on which a sound policy could be built.

Mr. M. G. Kendall wished to associate himself strongly with what Mr. Vigor said at the beginning of his remarks. It was ten years since a member of the Ministry who had been in charge of the Statistical Branch had read a paper before the Society, that member being Mr. Vigor himself. Nevertheless the association between agriculture and statistics was exceedingly close. One of the most important items of the Agricultural Output in this country was the flood of results of theoretical interest—produced mainly at Rothamsted—which were based on agricultural problems. As a member of the Ministry he took pride in its renewed association with the Society, and as a Fellow of the Society he hoped that another ten years would not elapse before a member of the Ministry addressed one of its meetings.

On the paper itself he would like to refer to the prices on which the index number was based. A chain was only as strong as its weakest link, and this question of price might be looked at a little more closely. They were told that the prices from which the index was computed was not the true weighted average price, but a simple mean of market prices; that these prices depended upon the personal judgment of the reporter; that even if the individual reporters were at fault, the errors of a large number of reporters might cancel out; and that even if they did not, it would not affect a comparison of indices from year to year. This reminded him of the case of the customs official who discovered an undeclared box of cigars, and was offered a bribe to say nothing about it. He replied he could not accept the bribe, as his conscience would not allow it; that even if it would there were strict regulations against such a thing; that even if that were not so, there was a Superintendent standing near, and anyhow 50 francs was not enough.

All the same, checks on some of the Ministry's figures which had become available in recent years had shown them to be surprisingly accurate. The Ministry's weekly prices for fat cattle in 1936 differed from the Cattle Committee's figures on the average by less than 0·5 per cent. Whether the prices for fruit and dairy produce were so good was more doubtful, but on the whole it appeared that the index was reliable so far as prices were concerned.

No attempt had apparently been made to gauge the precision of the index number as given. The Committee had, however, considered a rather similar point when they decided not to give weights to more than the nearest 0·5. One might fairly enquire how far it was justifiable to give the index number to the nearest unit. That had some practical importance, because sometimes the index number varied by only one or two points from one year to the next, and one would like to know whether such a variation indicated any real change, or whether it was purely due to uncontrolled fluctuations in the method of calculating the number itself.

MR. E. F. NASH said that an index number of agricultural prices was inevitably, in this country at least, a relatively humble member of the great family to which it belonged. Its influence and importance could never be compared with those of its big brother at the Board of Trade. The Ministry of Agriculture could not concern itself with the measurement of the general level of prices, or of changes in the general value of money. The index number of agricultural prices confined itself to an attempt to measure the influence of price changes on the value of the agricultural output. But the agricultural output was influenced by many other factors besides the prices of products. Mr. Vigor had rightly emphasized that the index of agricultural prices took care to disregard these other factors, so that from it alone no precise indication should be expected of the actual movement of agricultural output or income.

As Mr. Vigor had also suggested, the farmer might perhaps complain that he had been given a suit of clothes which did not fit, because it had been cut to the measurements of an abstraction, the "average" farmer. The index was not designed to show the influence of price changes on the receipts of any individual farmer, but on the aggregate receipts of all the farmers of England and Wales. Mr. Nash agreed that, ideally, separate index numbers for different types of farming would be desirable, but in practice there were rather formidable difficulties to be faced before such index numbers could be constructed.

Turning to the more theoretical and technical questions raised by the problem of measuring changes in agricultural prices, Mr. Nash said that the measurement of changes in the prices received by a group of producers or sellers had perhaps claimed less of the attention of theorists than the measurement of changes in the prices paid by consumers or purchasers. As Mr. Houghton had pointed out, the argument used by Professor Pigou to show the limits between which the ratio of change in the command of money over satisfactions might be presumed to lie, could be applied to the present problem with little more than verbal alterations, except of course that the two limits were transposed. The weighting formula which gave Pigou his lower limit would give in the present case the upper limit, and vice versa. The fact that the formulæ for the upper and lower limits were transposed was due, of course, to the opposite reactions of consumers and producers respectively to a relative rise in the price of an item of consumption or production. Consumers consumed less of it, but producers produced more of it. One consequence was that the use of pre-War weighting had opposite effects on the agricultural index number from those which it might be expected to have on an index, for example, of the cost of living. It made the agricultural index too low when the present day was compared with the pre-War period, but (except in so far as it might be counteracted by other influences) it would theoretically tend to make a cost-of-living index too high when making the same comparison.

This difference had some bearing upon certain arguments sometimes applied to the construction of index numbers. For example, the memorandum explaining the revision of the Board of Trade index number of wholesale prices in 1935 pointed out, in justification of the use of the geometric mean, that this method of averaging "had the effect of reducing the influence of upward movements in prices and increasing that of downward movements, modifications that correspond to the decreased or increased consumption that is likely to accompany such movements." That was no doubt a perfectly relevant observation as far as the Board of Trade index number was concerned, but if an upward movement were accompanied, not by diminished consumption, but by increased production, it seemed to follow that the geometric mean would give a worse and not better result than the arithmetic. The passage quoted, when applied to the different problems of the Ministry of Agriculture, seemed to provide an argument in favour of some such system as the gradual modification of the weighting which the new agricultural index number would actually employ.

This system of moving weights was the most novel, and for that reason perhaps the most controversial feature of the new index number. Dr. Wishart had asked if there were any parallel, and Mr. Nash knew of none nearer than New Zealand, although an exactly parallel system of weighting was used there in the construction of the index of export prices.

Mr. Houghton had described the new system as one which would enable the new series to run on indefinitely. He hoped that would not be taken to mean that the Ministry was now proposing to go to sleep and have no new ideas on the subject. The real purpose of the system was to enable comparisons to be made between adjacent or nearly adjacent years, without frequent changes of the base period, when there was no other reason for such changes. It might be objected that almost any reasonable system of weighting would fulfil this purpose save when price movements were exceptionally violent. Mr. Nash had no answer to this objection: he thought it was perfectly true; but if the weighting system hitherto in use was good enough for comparing one year with the next, the comparison it gave with the pre-War years was open to suspicion. For this reason the index as a whole demanded revision, and a new weighting system was called for in order to forestall the charge that an old patch had been put on to a new garment.

The fact that the character of the weighting system made little difference to the results of a comparison over short periods was worthy of emphasis. Where the dispersion of price movements was small, differences of weighting had relatively little opportunity of making themselves felt, and until the output had had time to respond to the effects of such dispersion, the relevance of the weighting system appropriate to the beginning of the period would not be greatly impaired. It was a consoling reflection to those who would be using the new index number that, however the figures were juggled, the results would be much the same. The same circumstances should prevent one from attaching too much importance to the theoretical considerations to which he had referred.

MR. HOUGHTON, in reply, said : First of all I should like to express my thanks for the very kind words used by the mover and seconder of the vote of thanks, as well as by subsequent speakers, and for the way in which the motion was accepted by all present.

In the limited time at my disposal I can only deal with two or three of the main points, and that very briefly.

Mr. Vigor has referred to the valuable information contained in the Ministry's statistics that only remains to be quarried further. I would like to assure him that this is due to no lack of zeal on the part of the statistical officers of the Department, but rather to other causes over which the Ministry has not complete control. There are only twenty-four hours in a day, and there is also a limit put by outside authority on the amount of time that civil servants can devote to statistics. I can assure Mr. Vigor, however, that we use to the full extent the staff available for work on statistics. We are only too anxious to do so, and to get all the information that we can out of this most valuable material.

I should like to deal with three points raised by Sir Alfred Flux in his remarks. The first related to our method of adding to our information on the agricultural output and the rather novel method we have adopted for keeping that information up to date. Unlike the Board of Trade, who take a complete census of production once in every five years, the Agricultural Departments are authorized by Statute to take a limited census of agricultural production every year, and to that extent we are very fortunate. That limited census covers the areas under the various crops and the numbers of livestock on the farms, and, in addition, we are authorized to collect the annual statistics as to the number of workers employed. Unfortunately that information is not sufficient to enable us to make an estimate of the total agricultural output, gross or net; for that purpose we require further information which we are not authorized to compel farmers to give us. This includes such things as the output of milk per cow, the average number of eggs laid per hen, the birth rates and death rates of the different kinds of livestock, and so on: information that is vital if we are to use the annual statistics in order to make an estimate of the agricultural output. Output does change as time goes on; farmers have in post-War years improved their methods very considerably and have raised the output of milk per cow and eggs per hen. In the past the Ministry made arrangements to collect this additional information once every five years, but experience had shown that with the other pressing duties that the officers had to conduct from day to day, the huge mass of this quinquennial information was a great burden and a considerable time elapsed before the results could appear. The exigencies of the Department made it impossible for us to put the necessary number of staff on to this work in order to get the information out quickly. It was thought that we could improve on that by getting this additional voluntary information in five annual instalments, and it was decided to get information for different groups of agricultural products each year. In the first year we had a census of the output of glass-house produce; last year of the output of milk; and so on. Consequently farmers are now asked to give certain information voluntarily each year in addition to the compulsory statutory information; they get accustomed to giving it, and we therefore expect to get better returns. On the other hand, the information that comes into the Department is less massive and can be dealt with more quickly; each year we can deal with the year's supply of information; the staff can be kept more evenly employed; and the data for estimating the annual agricultural output are kept more up to date.

The second point referred to by Sir Alfred Flux dealt with our average prices. Sir Alfred pointed out that I had been at pains to explain that our index numbers did not represent commodities homogeneous throughout the series. That is very true and very unfortunate, but, unhappily, from this point of view agriculture cannot be expected to conform to the convenience of the statistician. We have seen that particularly in the case of milk; there the changes of recent years have played havoc with our index number of milk prices. But unfortunate as the absence of homogeneity is, I do not know what we are expected to do about it, other than the action described in my paper. If fat cattle at this time of the year are different from fat cattle in October or September, because they are now fed on concentrated feeding-stuffs, whereas in the autumn they come off the grass, how can we compute a series of monthly index numbers of actual price changes of fat cattle that represents a homogeneous commodity throughout the series?

Sir Alfred also referred to the defects of the straight average for price quotations of eggs. A weighted average would, of course, be preferable to a straight average. But there is no information available for the purpose of calculating a weighted average. We do not know how many eggs are sold on a particular day, or in a particular week or month. We can only estimate the number of eggs sold in a year. I have, however, stated in my paper that the correction of the monthly index numbers for seasonal variation will be somewhat similar to the use of changing monthly weights.

That is all I have time to say on the points raised in the discussion. I should like once again to thank the speakers for their kind words.

As a result of the ballot taken during the meeting the candidates named below were unanimously elected Fellows of the Society :—

Noel Frederick Hall.
Eldred Frederick Hitchcock, C.B.E.
Thet Maung.
Edward Arthur George Shrimpton.
William A. Wilson, M.B., B.S.

THE STATISTICS OF THE RUBBER INDUSTRY

By GEORGE RAE, D.SC.

[Read before the ROYAL STATISTICAL SOCIETY, February 15th, 1938, SIR ALFRED FLUX, C.B., LL.D., HONORARY VICE-PRESIDENT, in the Chair.]

I. INTRODUCTORY

THE world's supplies of rubber come, at present, almost entirely from the latex which occurs in the bark of the tree known as the *Hevea Braziliensis.* The latex, which issues when the bark is cut, is collected, coagulated with an acid—generally formic or acetic acid—and the coagulum is washed and dried. The resulting product is the crude rubber of commerce. During recent years, however, there has been a growing demand for rubber in latex form, either natural or concentrated, and this demand, although relatively small at present, is likely to increase.

Until the beginning of the present century the world received the whole of its supplies from trees occurring naturally in tropical countries—mainly the Amazon Valley and Central Africa. The seeds from which the existing plantation industry has sprung were collected in Brazil by Wickham in 1876, were germinated at Kew, and the seedlings were dispatched to Ceylon and Singapore in the same year. After nearly a quarter of a century of experimental work with various rubber-producing plants, the superiority of the *Hevea Braziliensis,* both for cultivation in plantations and for the quality of the product, was definitely established. During the same period two other developments along totally different lines also passed beyond the experimental stage. Without the internal-combustion engine and the pneumatic tyre, the rubber industry would still have been important—its economic future had been assured by the discovery of vulcanization in 1839—but it would not have ranked, to-day, as one of the world's great industries. In 1895 the first petrol-driven automobile with pneumatic tyres was put on the roads. In 1937 over 40 million motor vehicles were in existence; they used about three-quarters of a million tons of crude rubber, or roughly two-thirds of the total world consumption during that year. Nearly 98 per cent. of the world's annual requirements of rubber is now derived from plantations.

The plantation-rubber industry is confined largely to the group of countries in the south-east of Asia: Malaya, Netherlands East Indies, Ceylon, South India, Burma, French Indo-China, Siam, Sarawak and British Borneo. The only sources of rubber outside these countries are the Firestone plantations in Liberia, a few small and unimportant plantations in other parts of Africa, in America and in Asia, and the comparatively small quantity of rubber from the naturally occurring trees in the Amazon Valley and Central Africa. The establishment of the industry in South-East Asia was initially due to the desire of the India Office to provide a new commercial product in India, but the principal reasons for the development there were undoubtedly economic—suitable soils and temperatures; rainfall adequate in amount and in distribution; convenient transport; settled Governments (mainly British and Dutch); and, most important of all, proximity to enormous reservoirs of efficient labour in the densely populated countries of India, China and Java.

The pioneer work in establishing this vast industry was carried out during the last quarter of the nineteenth century mainly by British and, later, by Dutch planters, in co-operation with the staffs of the Government Botanic Gardens in Ceylon, in Malaya and in Java, and many species of rubber-producing plants were experimented with before the ascendancy of the *Hevea Braziliensis* was finally established. During that period, although consumption of rubber was expanding, the naturally occurring trees seemed capable of supplying all the rubber which the world required. There was, therefore, no great inducement to start planting on a large scale, and by 1900 not more than 5,000 acres had actually been planted. The sudden popularity of motor transport in the early years of the current century completely changed the picture. The increased demand for rubber put a strain on the existing supplies, the price rose steadily, culminating in the rubber boom of 1910, when it reached 12*s.* 9*d.* per lb., and planting proceeded at a very rapid rate. At the end of 1936, nearly 8½ million acres were planted with rubber.

Although the Europeans were the first to start planting on a large scale, their example was followed by the natives, who interplanted rubber amongst their tapioca and fruit trees, or in clearings in the jungle which they had to make for the purpose of growing rice.

Plantation rubber is thus divided into two sections:—

Estate rubber. Rubber produced on estates owned and managed by Europeans or on large Asiatic estates managed on similar lines. These estates all contain over 100 acres of rubber, and the average area of planted rubber held by companies and individuals is about 3,000 acres.

Native rubber. Rubber produced on small holdings owned by the natives. These are practically all less than 100 acres; the average area of planted rubber per holding is in the neighbourhood of three acres.

II. PRODUCTION

Crude rubber is divided into two categories :—*Plantation rubber*, which is obtained from cultivated trees, and *Wild rubber*, which is obtained from the naturally occurring trees.

(a) *Plantation Rubber*

(1) *The planted area.*

At the end of 1936 the total area planted with rubber amounted to approximately 8,433,000 acres. The distribution of this area by countries and by nationality of ownership is given in Table I. The

TABLE I

Area under Rubber at December 31st, 1936

(In 1,000 acres)

Producing Country	Estates over 100 Acres								Holdings under 100 Acres (Asiatic) (9)	Grand Total (10)	Per cent. of Total (11)
	British		Dutch (3)	Other European (4)	American (5)	Total European and American (6)	Asiatic (7)	Total (8)			
	Domiciled										
	In United Kingdom (1)	Locally (2)									
Malaya ...	1,139	300	—	18	33	1,490	504	1,994	1,279	3,273	38·8
Ceylon ...	160	100	—	—	—	260	90	350	255	605	7·2
Netherlands East Indies...	405	30	706	180	133	1,454	40	1,494	1,800	3,294	39·0
India	40	15	—	—	—	55	24	79	49	128	1·5
Burma... ...	25	10	—	—	—	35	31	66	41	107	1·3
British North Borneo ...	45	4	3	2	—	54	17	71	56	127	1·5
Sarawak ...	4	—	—	—	—	4	17	21	195	216	2·6
French Indo-China ...	—	—	—	301	—	301	—	301	10	311	3·7
Siam	—	—	—	—	—	—	—	—	250	250	3·0
Africa, etc. ...	15	15	—	15	70	115	4	119	—	119	1·4
Total ...	1,833	474	709	519	236	3,771	727	4,498	3,935	8,433	100·0
Per cent. of Total ...	21·7	5·6	8·4	6·2	2·8	44·7	8·6	53·3	46·7	100·0	—

totals for estate and native rubber in the Eastern countries have been abstracted mainly from official data. They are probably as reliable as it is possible to obtain, but the accuracy of the estate data is, of course, greater than that of the native data. The distribution of the estate areas amongst the various nationalities of ownership has been based on published data of European- and American-owned companies' reports, supplemented by data collected locally.

Of the area planted at the end of 1936, 53 per cent. was on estates and 47 per cent. on native holdings. Furthermore, over 53 per cent. was planted in Empire countries, and an additional 5 per cent. was British-owned in the Netherlands East Indies.

The distribution of the planted area by years of planting is given in Table II. Data for the annual plantings previous to the year 1920 are very fragmentary, and the figures given are subject to a considerable margin of error, but the data for the total area, now in existence, and planted before the end of 1919, and for the annual extensions after 1919, in the Eastern countries, with the exception of those for native rubber in the Netherlands East Indies and Siam, are more complete and reliable. The annual plantings of native rubber in the Netherlands East Indies are based on reports by various observers and are, in fact, largely guesswork. A census of native trees and estimates of their average planting density in the various native-producing districts was made by the Netherlands East Indies Government in 1936, and resulted in an estimated area of 1,683,000 acres, to which has to be added some 15,000 acres in Java. This figure is now believed to be too low, as many of the natives, fearing taxation, did not declare their holdings until they discovered that the object of the census was to issue export rights

TABLE II

Area Planted with Rubber Annually, 1909–36

(In 1,000 acres)

Period	Estate			Native			Total	Average Price Ribbed Smoked Sheet, London
Area Planted	Seedling (1)	Budded (2)	Total (3)	Netherlands East Indies (4)	Other (5)	Total (6)	(7)	(8)
								s. d.
Up to 1909 ...	439	—	439	5	73	78	517	
1910–14	1,097	—	1,097	50	534	584	1,681	4 $10\frac{1}{4}$
1915–19	868	1	869	295	549	844	1,713	2 $6\frac{1}{4}$
In 1920	148	3	151	50	78	128	279	1 $10\frac{1}{4}$
„ 1921	71	4	75	5	27	32	107	$9\frac{9}{16}$
„ 1922	41	5	46	5	30	35	81	$9\frac{5}{16}$
„ 1923	57	8	65	50	45	95	160	1 $3\frac{5}{16}$
„ 1924	93	8	101	125	58	183	284	1 $1\frac{7}{8}$
„ 1925	125	11	136	275	113	388	524	2 $11\frac{1}{16}$
„ 1926	170	42	212	275	155	430	642	1 $11\frac{3}{4}$
„ 1927	219	57	276	250	151	401	677	1 $6\frac{7}{16}$
„ 1928	147	90	237	175	106	281	518	$10\frac{3}{4}$
„ 1929	52	99	151	125	76	201	352	$10\frac{1}{4}$
„ 1930	74	117	191	60	54	114	305	$5\frac{15}{16}$
„ 1931	11	138	149	20	15	35	184	$3\frac{1}{8}$
„ 1932	17	79	96	5	13	18	114	$2\frac{5}{16}$
„ 1933	13	48	61	10	11	21	82	$3\frac{1}{4}$
„ 1934	12	26	38	20	24	44	82	$6\frac{1}{4}$
„ 1935	8	22	30	—	16	16	46	6
„ 1936	33	45	78	—	7	7	85	$7\frac{1}{4}$
Total ...	3,695	803	4,498	1,800	2,135	3,935	8,433	

and that these rights could be sold for cash. I have, therefore, raised the estimate to 1,800,000 acres. The figures for Siam, Africa and other countries have also been estimated, as little data of any kind has been published.

New extensions in the past have been stimulated largely by a high price for rubber, and planting programmes then laid down have been completed a few years afterwards, frequently when the stimulus of the high price had effectively disappeared. During the last thirty years new planting has had the effect of increasing productive capacity. In future years part of the replanting and of any new planting that may be allowed under a new international agreement will be required to maintain the existing productive capacity.

During the period of the current international agreement (June 1st, 1934, to December 31st, 1938) new extensions, except 31,000 acres in Siam and a maximum of about 20,000 acres for experimental purposes in the other countries, have been prohibited in all countries signatory to this agreement. Each producer in these countries, however, could uproot and replant up to 20 per cent. of his area under rubber at June 1st, 1934. The actual amount of replanting which is likely to be carried out will be much less than the quantity permitted.

The figures for estate rubber have been divided into unbudded and budded areas. Up to about 1920 most of the extensions to the planted area on estates were made by planting seeds collected at random from the trees. After 1920 seeds from high-yielding trees were generally used, but as the other parent of the seed was unknown, the average yield from these plantings was probably not much higher than the general average of all trees, and was below the yielding capacity of the mother trees. Exact comparisons are not possible, as the systematic elimination of the poor-yielding trees has since then been carried out far more thoroughly.

As early as 1917 various attempts had been made to improve more rapidly the yielding capacity of the trees by grafting a bud from a known high-yielding tree on to a seedling of another tree. Five years have to elapse before the young budded trees can be tapped, so that this experimental work was naturally a lengthy process. But by 1923 it was established that, at any rate, certain high-yielding trees had the capacity of transmitting their high-yielding quality to their budded offspring. All high-yielding trees, however, do not possess this quality, and even amongst those that do, their budded offspring may develop undesirable qualities—poor resistance to wind or disease, or unsatisfactory bark renewal. The budding of rubber did not extend rapidly until it was possible to obtain budwood from proved stock, *i.e.*, from trees the budded offspring of which could retain the high-yielding capacity without developing undesirable characteristics. A further step has recently been taken by planting with clonal seeds—that is, seeds both of whose parents came from high-yielding trees; although only very small areas have been planted with such seeds, the results are promising.

The date of planting of the seedling rubber is generally the date at which the seed was first put into the ground, whether in a nursery or in the field. The date of planting of budded rubber is the date when the budded stump was transferred from the nursery to the field. In the case of rubber budded in the field, the date of the planting of the seed or the date midway between the planting of the seed and the grafting of the bud is sometimes taken.

The initial planting density on estates is generally over 200 trees to the acre for seedling and about 180 for buddings, which are more expensive. By the tenth year, when the yielding capacity of the trees has become established, the density is reduced to 120 to the acre by eliminating the poorer yielders. As the trees become older even this density hinders their development, for bark renewal seems to depend on their rate of increase in girth, and further thinning out has to be done. Wind and disease (mainly root disease) also play an important part in reducing the density, and by the time the trees have reached twenty-five to thirty years a stand of 60 to the acre, or even less, is common.

Native planting has been carried out with any seeds available, and little attempt seems to have been made even to use the seed from high-yielding trees. The budded area in native holdings is insignificant. The planting density is much greater than on estates. It shows considerable variations within each country, and its average varies from country to country. The average number of native trees per acre is about 220 in Malaya, 350 in the Netherlands East Indies, and about 150 in Ceylon. Apart from wind or disease, no thinning out is done.

Of the total area under rubber only about 375,000 acres are owned by (a few of the larger) rubber manufacturers. The total output of the manufacturer-owned area during 1937 was under 75,000 tons—far below the total requirements of their owners and less than 7 per cent. of the total world absorption of rubber.

(2) *Capital cost per planted area.*

The issued par capital per acre of rubber-producing companies has frequently little relation to the actual amount of money expended per acre to bring the plantation to the bearing stage fully equipped with buildings and machinery. For the existing planted area on estates the average sum so expended has been between £55 and £60, and it is doubtful if it could be done for less to-day. This does not allow anything for the seven or eight years which must elapse between the raising of the capital and the payment of the first dividend. Many companies show an issued capital per acre much below this figure, but on examination it will be found that these companies have issued shares at a high premium, or have developed considerable areas out of revenue, or have purchased other estates at a low price per acre in times of depression. Other companies show a much higher figure, partly because some wrote up their capital after the War, when prices seemed to have moved to a much higher level, partly because they were developed during the period of higher wages and prices, and partly because some unforeseen expenditures had to be undertaken. The premium paid for the land, the accessibility and the nature of the land, are the more important variable factors in the cost of development.

(3) *Output.*

As less than 1 per cent. of the world output of crude rubber is turned into manufactured goods in the countries of production, the exports from producing countries give a fair first approximation to actual output. Output has to provide for exports and for the necessary increase in working stocks inside the producing countries. Hence, the figures for exports of plantation rubber, given in Table V, will generally be somewhat less than the actual crop. A further adjustment has to be made in the figures for 1918, 1919, 1920 and 1921. Owing to shortage of freight during the last year of the War, about 50,000 tons of 1918 rubber were exported in 1919, and, owing to the depression, 20,000 tons of 1920 rubber were exported in 1921. Accurate figures are now available for estate output in Malaya and in the Netherlands East Indies, and more data on stocks inside producing countries have been collected during the last few years. Hence it is now possible to get a closer approximation to output, and at the same time to distinguish the output of estates over 100 acres from that of holdings under 100 acres. The output figures for the years 1929-37 are given in Table III, but, except for estate output in Malaya and in the Netherlands East Indies, all the other figures are subject to some margin of error.

The year 1929 is the only year since 1919 in which anything like normal conditions prevailed in the producing industry. As will be seen later, output was affected by a voluntary regulation scheme during 1920–21, by the Stevenson Scheme during the years 1922–28, and by the existing scheme since June 1st, 1934. During the years

TABLE III

Production of Rubber, 1929–37

(In 1,000 tons)

Country	1929 (1)	1930 (2)	1931 (3)	1932 (4)	1933 (5)	1934 (6)	1935 (7)	1936 (8)	1937 (9)
1. From Estates over 100 acres :—									
Malaya	246·0	237·3	239·9	240·5	241·5	263·1	242·9	233·1	314·6
Ceylon	51·0	50·2	38·7	32·5	40·7	50·0	36·0	33·0	48·0
Netherlands East Indies	151·7	151·1	163·2	148·5	169·5	185·2	150·7	157·0	239·6
India	6·0	5·3	4·2	1·1	2·0	7·0	10·0	10·0	11·5
Burma	4·2	3·6	3·0	2·1	2·8	4·6	5·3	6·0	7·0
British North Borneo ...	6·3	5·7	4·7	4·0	5·0	7·0	5·3	4·7	8·0
Sarawak	1·2	1·2	1·0	1·0	1·0	2·0	2·0	2·0	2·5
French Indo-China ...	9·3	9·4	10·6	13·5	17·4	18·9	28·2	38·2	16·0
Siam	—	—	—	—	—	—	—	—	—
Others	2·5	2·1	1·4	0·8	1·1	2·3	3·5	4·7	7·2
Total Estate ...	478·2	466·2	466·7	444·0	481·3	510·1	483·9	488·7	684·4
2. From Holdings under 100 acres :—									
Malaya	200·8	198·8	196·1	177·5	219·3	217·8	135·5	131·9	188·5
Ceylon	25·0	25·0	22·0	17·0	25·0	30·0	18·0	17·0	24·0
Netherlands East Indies	106·4	89·1	87·3	60·5	114·3	183·1	142·6	149·0	211·3
India	2·0	1·7	1·3	0·4	0·5	2·0	2·5	3·0	3·5
Burma	1·8	1·5	1·3	0·9	1·2	1·9	2·2	2·5	3·5
British North Borneo ...	1·2	1·3	1·3	1·5	3·0	4·0	3·7	3·3	5·2
Sarawak	10·3	9·8	9·5	6·5	10·5	16·0	17·5	19·0	22·2
French Indo-China ...	0·2	0·3	0·4	0·5	0·6	1·1	1·3	1·5	2·0
Siam	4·3	4·7	3·6	3·0	7·0	18·0	29·0	35·0	36·0
Others	0·2	0·3	0·1	0·2	0·2	0·3	0·3	0·3	0·4
Total Native ...	352·2	332·5	322·9	268·0	381·6	474·2	352·6	362·5	496·6
3. Total :—									
Malaya	446·8	436·1	436·0	418·0	460·8	480·9	378·4	365·0	503·1
Ceylon	76·0	75·2	60·7	49·5	65·7	80·0	54·0	50·0	72·0
Netherlands East Indies	258·1	240·2	250·5	209·0	283·8	368·3	293·3	306·0	450·9
India	8·0	7·0	5·5	1·5	2·5	9·0	12·5	13·0	15·0
Burma	6·0	5·1	4·3	3·0	4·0	6·5	7·5	8·5	10·5
British North Borneo ...	7·5	7·0	6·0	5·5	8·0	11·0	9·0	8·0	13·2
Sarawak	11·5	11·0	10·5	7·5	11·5	18·0	19·5	21·0	24·7
French Indo-China ...	9·5	9·7	11·0	14·0	18·0	20·0	29·5	39·7	18·0
Siam	4·3	4·7	3·6	3·0	7·0	18·0	29·0	35·0	36·0
Others	2·7	2·7	1·5	1·0	1·6	2·6	3·8	5·0	7·6
Total Plantation ...	830·4	798·7	789·6	712·0	862·9	1,011·3	836·5	851·2	1,181·0
Wild	27·1	18·7	15·1	8·3	12·0	11·9	15·7	19·0	21·0
GRAND TOTAL ...	857·5	817·4	804·7	720·3	871·9	1,026·2	852·2	870·2	1,202·0
Average Price Standard Quality Ribbed Smoked Sheet London, Pence per lb.	10·3	5·9	3·1	2·3	3·2	6·1	6·0	7·7	9·5

1929–33, inclusive, the output of rubber was determined entirely by natural and economic factors, and the effect of the low prices during the depression, both on the estate and on native output, is clearly seen. A glance at Table II shows that the productive capacity, both of estate and native rubber, should have increased steadily after 1929, as the large areas planted after 1923 gradually reached full maturity. The actual output of estate rubber, however, remained nearly stationary. In 1932, when it reached its lowest level, it was only 6 per cent. below its 1929 amount, and the increase during 1933 took place mainly in the latter part of the year, when higher prices prevailed in anticipation of the introduction of a regulating scheme. But the proportion which estate output bore to its productive capacity during those years steadily decreased, until it reached about 80 per cent. in 1932. During this period (1929–32) a comparatively small number of companies ceased to produce rubber. Most of those companies had adequate reserves which could support their estates on a care-and-maintenance basis for a considerable period. Others, in Ceylon and South India, in addition to having adequate reserves, were also producers of tea, and they devoted their energies to that culture. A much greater number of companies, however, rested considerable areas of their estates or tapped only their more productive trees. Finally, there were many estates which, either because of lack of reserves or for other reasons, were more or less compelled to tap to the utmost at the risk of impairing the continued productivity of the trees. Throughout this period no estate rubber-producers went bankrupt, although a few companies had to be reconstructed with an additional call on their shareholders, and one or two with debentures were foreclosed by the debenture-holders. The vast majority of estate-producers, by drawing on their cash reserves, or, in some cases, on their reserves of tappable bark, existed as effective producers until the introduction of the regulating scheme in 1934. So long as the actual cost of collection, manufacture and transport was less than the price obtained for the product, it paid the estate to continue to produce, although in every case it was living to a greater or less extent on its capital. But to keep these costs below a steadily falling price, salaries and wages were reduced to a bare subsistence level, all estate works not immediately essential were stopped, and labour surplus to the barest needs was dismissed, and in Malaya and Sumatra was repatriated respectively to India and Java. Estate output was largely determined by the relation between the price and the cost of collection, manufacture and transport (which, as will be seen later, is very different from the real cost of production). This struggle for survival could take little account of the world's requirements; more rubber was produced than required, and the price inevitably declined. In time many estates would have come to an end of their financial resources, and would either have been abandoned or sold to anyone who could afford to buy them. If abandoned, or if sold and put on a care-and-maintenance basis, their potential productive capacity was not destroyed; on the contrary, it was improved by resting. Even if sold to anyone who tapped until the bark reserves were used up, most of the trees, after a few years resting, would again, with renewed bark, have become potential producers. Productive capacity cannot be seriously destroyed by a low price.

Estate producers have to look on their property as a capital asset. They must, under normal conditions, arrange their tapping and planting policy to ensure continuity of production over a long period of time. The native has a totally different outlook. He regards his property merely as a source of income, since it has been developed by his own labour. In Malaya a large number of native producers are entirely dependent on their rubber, and must tap their trees in order to obtain the bare necessities of life. For many of those natives when the price was falling their output had to increase. The remaining native producers in Malaya and the majority of such producers in the Netherlands East Indies and elsewhere grow their own foodstuffs. They depend on their rubber sales for money to pay taxes and to buy the things they cannot produce themselves. The natives generally continue to tap their trees so long as they can find a market for their product, and with a falling price accessibility to the market largely determines their output. In a well-developed country like Malaya, transport costs did not begin to affect output until the London price was under 3*d.* per lb., and even in 1932, when the price averaged 2¼*d.*, the output was only 12 per cent. lower than what it had been during the previous three years. In the Netherlands East Indies, where transport conditions are much more primitive, restriction of output began at a much higher price level and increased continuously as the price fell. Their exports fell from 106,000 tons in 1929 to 60,000 tons in 1932, while their productive capacity was rapidly increasing, on account of their large extensions during the years 1924–29. As in the case of estates, however, if the rubber is not produced, the holdings benefit by the involuntary resting they receive.

The effect of a low and declining price on the output of rubber is more direct in the case of native holdings than in the case of estates, and when the price begins to rise after a prolonged period of low prices, native output responds more rapidly than estate output. For during the depressed period a considerable portion of estate labour will have been repatriated, and, before the estates can again come into full production, labour has to be recruited and trained. On the other hand, a high, but varying, proportion of the native output is produced by the owner and his family. The available labour is thus always on the spot, and immediate advantage can be, and is, taken of any rise in the price. Furthermore, there is always some additional labour locally available in the native producing districts, and when this labour is employed by a native, it generally receives as wages one-half or two-thirds (sometimes even a greater proportion) of the rubber it collects.

The production of rubber in its present marketable form is well adapted to native cultivation. Once the seeds have been planted, little attention is required, or bestowed, by the native, even when the trees have reached the tappable age. Tapping can be done at any time throughout the year, and if natives are unable, or unwilling, to take the trouble to prepare their rubber for the world market, it can be sold in its unprepared form to dealers or re-milling factories, and can be converted into a product commanding only a slightly lower price than the standard quality product produced by estates. (See Table XVII.)

Furthermore, the natives dislike any apparently unnecessary labour. They seldom did any clean weeding—and have therefore conserved their top soil. In Malaya, at least, they have some of the most fertile land in the country. During the last ten years, except in 1929 (and in Malaya, probably also in 1930 and 1931), output has been curtailed either by the price or by regulation schemes. Most holdings have therefore had prolonged resting periods which has maintained—and probably improved—native productive capacity. But if the price were to be maintained over a long period, at a level which would enable all the native rubber to be brought to the market, the dense planting, drastic and careless tapping, neglect of disease control, would affect their total output more quickly than in the case of estates, unless some new planting were carried out each year. The estate carries its main bark reserves on its tapped trees, the native in the past has carried his reserves largely in his young, or untapped, trees.

Apart from the shipment of a small quantity of rubber in latex form, over 80 per cent. of the estate output is in the form of Standard Grades—Ribbed Smoked Sheet and First Latex Crepe; the remainder consists of off-grades. Practically the whole of the estate rubber is ready for the factory when it leaves the estate. Native rubber is sold as native sheets, re-milled blankets or scrap. Some natives prepare their sheet in an exportable form, but the greater part of the native output has to be processed further before it can be exported. Neither native sheet nor re-milled blanket can be offered for rubber sold through the settlement house in London.

In all countries producing plantation rubber there are fairly marked seasonal variations in output. The rate of output is at its lowest during the "wintering" period—that is, during or after the dry season, when the trees are putting on new leaves, and at its highest in the last quarter of the year, when rainfall is generally at its highest. In Malaya, Ceylon, the East Coast of Sumatra, India, Burma, Siam, French Indo-China, British North Borneo and Sarawak, the wintering period occurs usually in the first quarter of the year, and in Java, South Sumatra and Borneo it occurs in the third quarter. In each case it lasts from three to six weeks. Some indication of the seasonal variation in output is given in Table IV, which is based on the analysis of the crop returns of 607 companies made by the Rubber-Growers' Association. It refers to the year 1929 only, which, as already pointed out, is the only normal production year which the industry has experienced since 1919. Similar data have been published for 1930, 1931 and 1932, but conditions in those years were abnormal, and indices of seasonal production, based on them, are not likely to be of much value. The figures, of course, refer to estate rubber only, but they give a general idea of seasonal variation in total output. Separate data were given for estates in Java and for estates on the east coast of Sumatra. (These two districts account for over 75 per cent. of the Netherlands East Indies estate rubber.) Climatic conditions in the principal native growing districts in South Sumatra and Borneo are similar to those in Java, but other factors, *e.g.*, planting and harvesting of padi, etc., have also a definite effect on native output.

TABLE IV

Percentage Monthly Output during 1929 *of* 607 *Companies*

Data collected by Rubber-Growers' Association

Period	British North Borneo	Ceylon	India and Burma	Malaya	Netherlands East Indies		Total
	(1)	(2)	(3)	(4)	Java (5)	Sumatra (6)	(7)
Number of Companies	26	102	21	338	60	60	607
January	8·6	9·1	8·9	9·2	8·6	9·2	9·0
February	7·6	4·2	2·9	6·9	8·1	7·6	6·8
March	6·9	3·4	7·8	7·2	8·2	6·3	6·8
April	7·4	8·3	10·2	7·3	9·0	6·8	7·6
May	7·8	8·3	10·0	7·9	9·4	7·8	8·1
June	8·5	7·4	4·1	8·2	8·6	8·4	8·1
July	9·0	9·2	4·1	8·8	8·2	9·2	8·8
August	8·5	10·4	6·6	8·7	6·8	8·8	8·6
September ...	8·5	8·7	9·2	8·2	7·2	8·5	8·2
October	8·9	10·5	11·4	9·0	8·1	9·2	9·2
November ...	8·8	9·9	12·4	8·4	8·4	8·6	8·7
December ...	9·5	10·6	12·4	10·2	9·4	9·6	10·1
	100·0	100·0	100·0	100·0	100·0	100·0	100·0

(4) *Yields.*

(i) *Estate.* The data so far discussed on areas, output and planting costs, though subject to some margin of error, represent the more permanent and definite data on the industry. Figures on yields and costs of production come into a somewhat different category, mainly because the methods of cultivation, the systems of tapping and general estate procedure, on which these figures are based, have changed considerably during the last thirty years. Furthermore, the drastic tapping systems, clean weeding practices, and general lack of soil conservation in vogue during the early years of the industry have left their mark on old rubber, and the yielding capacity of much of this rubber during the next ten years is likely to be inferior to the younger seedling rubber (which has not been so badly handled in the past) when it reaches a corresponding age, notwithstanding the fact that a rubber tree can stand a great deal of rough usage and still produce rubber.

Like most other perennial cultures, the yield of rubber trees varies with the age of the tree. The age at which tapping commences depends on the girth of the tree near the ground and on the price of the commodity. Rubber trees generally become large enough to be tapped at about five years from planting or budding, but if the price is low it may not be profitable to tap at that age, and if not tapped the trees benefit from the resting.

At any given age the yield per tree per annum is partly an inherent characteristic (this is the basis of bud-grafting and seed selection) and partly environmental. The environmental factors include rainfall, soil conditions, cultivation, planting density, tapping system and previous tapping history.

The annual yield per tree from fully mature trees, say between the ages of fifteen and twenty-five, grown from unselected seedlings, varies from 2 lbs. to over 30 lbs. and averages about 5 lbs. The yield from twelve-year-old trees budded from proved stock has varied from about 9 lbs. to 30 lbs. and has averaged about 16 lbs. Data for proved buddings over twelve years of age are very inadequate, as most of the proved budded material has been planted since 1925.

The yield per tree per annum is used almost entirely in scientific and in experimental work. The unit in ordinary commercial practice is the yield per acre per annum. These yields are, of course, influenced by the same factors as the yield per tree, and in addition they are affected by the number of trees per acre. Rubber trees for their full development require sufficient room for their root and branching system, and for each field there is a definite density, depending on the age of the trees, which gives the maximum yield per acre. Selective elimination of the poorer yielders in the earlier years of tapping increases the yield per acre, and for the same reason the elimination by wind and disease in the later years may not exercise much effect on yields, unless these causes remove a number of contiguous trees.

Some indication of the variation of the average yield per acre with the age of the trees for unselected seedlings and for budded rubber is given in the following table. The unselected seedling data were collected in the Netherlands East Indies by Tengwall. They are based on 1929 outputs, and therefore do not include the output of any area planted after the end of 1923. The figures for budded rubber are the allowances initially made by the authorities in Malaya and the Netherlands East Indies in assessing the standard productions of estates for the purpose of the regulation scheme. Allowances for budded rubber in Malaya are given to proved stock only, and are higher than in the Netherlands East Indies, where allowances are given to all budded rubber. Commercial tapping in Malaya and in the Netherlands East Indies has shown that yields considerably higher than the scale allowances for each age-group are attained. Bark renewal in most of the clones is satisfactory (a clone is the budded offspring of an individual mother tree), and yields obtained from experimental tapping of renewed bark are maintained.

		Budded Rubber	
	Unselected Seedling	Malaya Proved Clones	Netherlands East Indies all Clones
Age, Years	Lbs. per acre	Lbs. per acre	Lbs. per acre
5– 6	204	200– 400	268
6– 7	249	460– 600	535
7– 8	267	650– 750	669
8– 9	294	790– 900	781
9–10	323	950–1,000	848
10–11	341	1,050–1,200	892
11–12	382		
12–13	359		
13–14	360		
14–15	400		
15–16	428		
16–17	404		
17–18	399		
18–19	399		
19–20	365		
20–21	396		
21–22	344		
22–23	361		

(ii) *Native.* Data on native yields are scanty. In Malaya, during the period 1929–31, the average yield per mature acre of native rubber was about 475 lbs., or about 20 per cent. higher than the corresponding estate seedling average. Similar or even higher yields may have been obtained in 1929 from native rubber in the Netherlands East Indies and Sarawak. The dense planting and heavy tapping on native holdings undoubtedly result in higher yields for a time, but the periods of enforced resting which native rubber has experienced during the last twenty years make any estimates of the continuous yields of native rubber largely a matter for conjecture.

(5) *Cost of Production.*

The calculation of the cost of production of a commodity may seem to be a simple matter, but, in the case of rubber at least, it is somewhat complex; moreover, it is impossible to calculate accurately the costs of British Rubber Companies from their published accounts. The method of arriving at a closer approximation to the true cost of production of estate rubber was recently considered by a Committee of the Rubber-Growers' Association, and their reports, containing a standard form for calculating costs, have been published in their *Bulletin.*[1] The elements which make up the cost of production were divided into five broad categories :—

(i) *The f.o.b. cost.* This figure includes all the revenue expenditure incurred in the East until the rubber is shipped, and all the necessary data are available on the estate. Until rubber trees reach the tappable stage their upkeep must be charged to capital, and the distribution of overhead costs between capital and revenue, for those producers who have immature rubber, has to be estimated. The Committee agreed that a distribution proportional to the areas of immature and mature rubber would give a fair approximation provided that, for this purpose, every immature acre, except the first year's clearings, is counted as half an acre.

(ii) *Freight and marketing charges incurred in disposing of the rubber in London.* Estate rubber is sold partly Landed London, partly on a c.i.f. basis, and partly in the East. The London price is the standard price for rubber. It is therefore necessary, in order to get comparable figures, to have a uniform figure for freight and marketing charges. This figure was taken at 0·60*d*. per lb. in 1934, and was raised for 1938 to 0·75*d*. per lb., mainly on account of increased freight rates.

(iii) *Head Office administration expenditure.* This figure, which in practice shows a considerable, and unnecessary, variation, was taken at 0·40*d*. per lb., and later was reduced to 0·30*d*. per lb.

(iv) *Staff commissions and various other items depending on profits.* These were taken at 0·20*d*. per lb., and afterwards reduced to 0·10*d*. per lb.

(v) *Depreciation of buildings and machinery and amortization of* *mature areas.* These two items are very important, and allowances for them must, in the nature of the case, be approximate. Most producers have made allowances in one form or another for depreciation of their buildings and machinery, either by writing off a certain percentage each year or by writing them down, in some particular year, to a nominal sum. Actual practice is so varied that the Committee decided that 7½ per cent. of a standard value should be written off each year, this percentage being in conformity with the experience of producers. No allowance for amortization of mature areas is ever explicitly made in the costs of British Companies. There can be no doubt that a rubber estate is a wasting asset, and some annual provision should be made to replace the trees once they have passed their economic life. British Companies have not been unmindful of this, and many have developed young areas out of revenue or set aside, from the annual profits, considerable reserves for this purpose. The great difficulty in arriving at an annual charge for amortization is that the economic life of seedling rubber, and still more that of budded rubber, is unknown. Furthermore, the introduction of budding may have the effect of shortening the economic life of seedling rubber. Some estimate, however, must be made, and the Committee arrived at the conclusion that the economic life of a rubber tree should be taken at thirty years (*i.e.*, twenty-five years of tapping), and to allow for this 4 per cent. should be written off the value of the estate each year. The value to which these percentages are to be applied should be the costs incurred in developing the estate, but these costs are frequently difficult to arrive at. Many companies have purchased developed properties, and the initial costs of buildings and machinery and of planting may be unknown to them; others, from purely accidental causes, may have incurred abnormal capital expenditure. The Committee decided that for the purposes of returning costs to the International Rubber Regulation Committee the percentage should be applied to the estimated costs incurred in developing a new estate.

Estimates for the development of such a property, under prescribed conditions, were obtained from authorities in the East. The average of those estimates for Malaya was £7 per acre for buildings and machinery and £35 per acre for planting with ordinary seedling rubber. (The additional estimated expenditure incurred in planting with budded rubber averaged £5 6*s.* per acre.) No allowance was made for interest on the capital until the estate reached the productive stage. These costs, which were estimated in 1934, are probably considerably below what would be required to-day, owing to the rise in prices and in wages, to the high premium demanded for conveniently accessible land, and to the fact that estimates are generally exceeded in practice. But accepting the figures as they stand, 10*s.* 6*d.* per acre must be written off each year for depreciation of buildings and machinery and £1 8*s.* per acre for amortization of mature areas. The allowances per lb. are arrived at by dividing these figures by the average yield per mature acre. For an estate producing an unrestricted crop of 400 lbs. per mature acre these allowances work out at 0·31*d.* per lb. for depreciation and 0·84*d.* per lb. for amortization—a total of 1·15*d.* per lb. With a crop restricted to 300 lbs. per acre the allowances are respectively 0·43*d.* per lb. and 1·12*d.* per lb.—a total of 1·54*d.* per lb. The cost data collected by the Rubber-Growers' Association are strictly confidential and are not available, but perhaps a fair average cost of production of an estate producer in Malaya, worked out on the above basis, during the second half of 1937, when the exportable percentage stood at 90, would be approximately as follows :—

	Pence per lb.
1. F.O.B. cost	3·75
2. Freight and Selling	0·75
3. Head Office Expenses	0·30
4. Profit sharing arrangements	0·10
5. Depreciation and Amortization	1·25
Total "All-in" cost	6·15

On a capital expenditure of £60 per acre the allowance for depreciation and amortization would be about 0·60*d.* per lb. higher.

These costs refer to Malaya only. For estates in the Netherlands East Indies, owing to the recent devaluation of the guilder, they are, at present, slightly lower. For the other important producing countries it is very difficult to obtain a representative sample, mainly because so many producers have more than one culture.

Estate wages and salaries are the most important item in the cost of production, and amount to about 60 per cent. of the f.o.b. cost. These items were reduced to a bare subsistence level during the slump, and their increase to a more reasonable level with the improved price of the commodity was to be expected. The price of the commodity has a definite direct influence on costs.

It is frequently stated that native costs are lower than those of estates. It is true that a native working his holding with his own family has not the same cash expenditure as the estate. Nor, if he employs labour, does he have to incur many expenses—housing, medical, recruiting, educational, workman's compensation, etc., which an estate is compelled by law to incur. Furthermore, the extent to which a native, by over-tapping, is living on his capital cannot be determined without a much greater knowledge of the condition of native holdings than we possess at present. If he employs labour—which he is inclined to do when the price rises—and pays his labour by giving it half the rubber it collects, his tapping costs vary directly with the price, bark consumption is heavier and tapping is even more carelessly done. Comparison of costs is therefore impossible, but experience has shown that a native who lives on his holding and who grows his own foodstuffs is not likely to be dislodged by a prolonged period of low prices.

(b) *Wild Rubber*

The exports of wild rubber reached their maximum in 1910, when 82,000 tons were shipped, and supplied at that time nearly 90 per cent. of the world's requirements. By 1937 the exports had declined to 20,000 tons, or roughly 2 per cent. of the 1937 requirements. "Fine Hard Para" from Brazil still remains a standard grade, and is used in diminished quantities, for specific purposes. The price at which plantation rubber is marketed limits the production of wild rubber to the most accessible trees. Moreover, except for "Fine Hard Para," the quality of the plantation rubber is better and more uniform than that of the innumerable grades of wild rubber, which at one time came on the market.

III. EXPORTS

The declared net exports of rubber from producing countries for the years 1910–37 are given in Table V. The figures for wild rubber include moisture and various impurities, and to arrive at the dry rubber content a deduction of 15–20 per cent. has to be made in the South American rubber, of 30–40 per cent. in African wild rubber, and, in the earlier years at least, 20–30 per cent. in Central American rubber. The figures for plantation rubber, which include the exports of latex, are all expressed in terms of dry rubber.

IV. IMPORTS

The declared net imports of rubber into all the manufacturing countries during the years 1910–37 are given in Table VI. As in the case of exports, these figures also include moisture and other impurities in wild rubber.

The figures for exports and imports, given in Tables V and VI, and production and absorption figures based on them, have been obtained from the official trade returns of the various countries. Rubber was not recognized officially in some countries as an important commodity before 1920, and the figures given for the years previous to 1920 are not so accurate as the later figures. Apart from the

TABLE V

Exports of Rubber, 1910–37

(In 1,000 tons)

Year	Malaya (1)	Netherlands East Indies (2)	Ceylon (3)	India (4)	Burma (5)	North Borneo (6)	Sarawak (7)	Siam (8)	French Indo-China (9)	Philippines and Oceania (10)	Africa (11)	South America (12)	Mexico (13)	Grand Total (14)
1910	6·5	2·4	1·6	0·2		0·1	—	—	0·2	—	20·0	44·0	18·0	93·0
1911	10·8	2·3	3·2	0·4		0·1	—	0·1	0·2	—	18·0	43·0	15·0	93·1
1912	20·3	3·7	6·7	0·7		0·2	0·1	0·1	0·3	—	19·0	49·0	12·0	112·1
1913	33·6	6·4	11·4	1·0		0·5	0·2	0·1	0·2	—	16·0	43·0	6·0	118·4
1914	47·0	10·4	15·8	1·3		0·6	0·3	0·1	0·2	—	8·0	38·0	1·0	122·7
1915	70·2	20·0	20·8	2·2		1·2	0·6	0·1	0·4	0·1	8·0	40·0	3·0	166·6
1916	96·0	33·1	24·4	2·8		1·9	1·0	0·1	0·6	0·2	10·0	38·0	2·0	210·1
1917	129·0	44·0	31·9	4·0		2·4	1·7	0·2	0·9	0·2	10·0	41·0	2·0	267·3
1918	112·0	42·0	21·1	4·4		2·6	1·5	0·1	0·5	0·2	7·0	27·0	3·0	221·4
1919	204·0	85·0	44·8	6·6		3·9	2·2	0·3	2·9	0·3	7·0	39·0	2·0	398·0
1920	181·0	80·0	39·0	4·2	2·2	4·1	2·2	0·4	3·1	0·4	6·0	30·0	1·0	353·6
1921	151·0	71·0	40·2	3·7	1·7	3·2	2·1	0·4	3·6	0·3	4·0	21·0	—	302·2
1922	214·0	94·0	47·4	3·2	2·0	3·8	3·8	0·6	4·5	0·1	3·0	24·0	—	400·4
1923	201·0	117·0	37·1	4·4	2·5	4·2	5·7	1·5	5·1	0·3	5·6	23·3	1·0	408·7
1924	183·0	149·0	37·4	4·6	3·7	4·6	6·7	2·5	6·5	0·4	5·4	25·1	1·5	430·4
1925	210·0	189·0	45·7	6·3	4·7	5·4	9·1	4·6	7·4	0·7	7·8	30·2	4·0	524·9
1926	286·0	204·0	58·8	6·5	4·5	5·8	9·9	3·5	8·1	1·0	9·5	26·7	4·0	628·3
1927	242·0	229·0	55·4	7·0	5·9	6·6	11·2	4·7	8·9	1·3	8·5	30·8	5·0	616·3
1928	299·0	229·0	58·0	7·2	4·8	7·0	10·6	4·1	9·1	1·3	7·5	21·6	3·0	662·2
1929	457·0	255·0	80·3	7·9	5·5	7·4	11·2	4·3	9·5	0·9	6·3	21·3	1·3	867·9
1930	443·0	242·0	75·6	6·8	5·2	7·1	10·6	4·7	9·7	1·2	4·9	14·3	1·0	826·1
1931	423·0	257·0	62·3	5·4	4·5	6·2	10·4	3·6	11·0	0·9	3·5	12·2	—	800·0
1932	406·0	211·0	49·3	1·1	3·0	5·4	7·1	3·0	13·5	0·8	2·0	6·5	—	708·7
1933	445·8	282·3	63·8	1·4	3·4	7·8	11·1	7·0	17·3	1·2	2·3	10·1	—	853·5
1934	467·4	379·4	79·1	6·5	6·3	11·1	17·6	17·7	19·6	1·4	3·5	9·1	0·4	1,019·1
1935	417·0	282·9	54·3	9·1	4·9	8·9	19·3	28·3	28·7	1·5	5·0	12·2	0·5	872·6
1936	353·7	309·6	49·7	8·6	5·9	8·2	21·0	34·6	40·8	1·6	6·1	14·6	1·2	855·6
1937	470·0	431·6	70·4	9·8	7·2	13·2	25·9	35·6	43·4	1·6	7·7	16·0	2·7	1,135·1

TABLE VI

Net Imports of Rubber, 1910–37

(In 1,000 tons)

Year	United States of America (1)	United Kingdom (2)	Australia (3)	Belgium (4)	Canada (5)	Czecho-slovakia (6)	France (7)	Germany (8)	Italy (9)	Japan (10)	Russia (11)	Other Countries (12)	Total (13)
1910	42·2	20·5	0·4	2·2	1·3	—	3·8	13·7	1·8	0·7	7·2	5·7	99·5
1911	41·9	16·7	0·5	2·0	1·6	—	5·1	15·1	2·4	0·9	6·6	5·9	99·0
1912	56·0	18·7	0·6	2·5	2·4	—	4·6	15·4	3·3	0·9	9·2	6·3	119·9
1913	52·2	25·3	0·8	3·6	2·1	—	6·5	16·3	2·5	1·2	12·6	7·5	130·6
1914	62·3	18·5	0·9	1·5	1·1	—	5·0	11·0	2·7	1·0	11·6	5·9	121·5
1915	99·0	15·1	1·0	—	3·2	—	10·8	1·0	5·0	1·7	14·2	6·9	160·9
1916	117·6	26·7	1·2	—	3·9	—	14·7	2·0	1·8	2·9	11·2	4·7	189·7
1917	179·3	26·0	1·2	—	4·0	—	17·0	1·0	5·6	3·7	8·8	2·7	249·3
1918	143·4	30·1	2·7	—	6·9	—	18·0	—	7·1	7·3	—	2·6	218·1
1919	238·4	42·7	1·0	4·0	6·4	—	20·1	4·5	9·9	9·8	0·1	10·2	347·1
1920	249·5	56·8	1·8	3·4	11·7	0·6	16·3	12·6	6·1	6·0	0·1	11·8	376·7
1921	179·7	42·1	1·0	1·7	8·1	0·6	14·8	21·6	3·9	21·0	0·2	7·7	302·4
1922	296·4	11·7	2·6	0·2	9·2	0·6	27·7	27·6	6·4	15·0	3·1	2·2	402·7
1923	301·5	12·7	1·6	2·2	13·3	1·1	28·6	18·5	8·5	16·0	4·5	8·0	416·5
1924	319·0	−11·6	3·1	2·7	14·3	1·4	31·7	22·7	8·8	19·7	1·5	8·0	421·3
1925	385·6	4·1	3·5	2·9	19·7	1·6	34·3	33·9	11·4	12·9	7·5	10·1	527·5
1926	400·0	84·9	9·0	2·5	20·2	1·8	35·7	22·8	9·8	18·3	7·0	11·6	623·6
1927	403·4	59·8	9·5	6·5	26·4	2·7	35·7	38·9	11·3	20·5	14·0	13·7	642·4
1928	407·5	4·4	8·4	7·9	30·9	3·1	38·0	37·9	12·4	25·8	8·0	19·9	604·2
1929	528·6	122·8	15·9	9·4	35·5	4·7	61·8	49·1	16·4	31·3	12·7	26·9	918·1
1930	457·4	120·0	5·4	10·7	28·8	4·5	71·4	45·8	18·6	33·0	16·7	27·3	839·6
1931	476·2	85·2	7·7	11·0	25·3	7·7	47·8	39·2	10·1	13·5	30·7	29·3	813·7
1932	393·8	43·5	12·4	9·5	20·9	9·5	41·7	45·0	15·3	56·1	30·0	33·9	711·6
1933	398·4	73·3	13·5	11·2	19·3	10·4	63·1	51·1	19·3	66·9	30·8	40·4	800·7
1934	439·1	158·5	9·6	9·1	28·4	11·0	50·4	59·3	21·4	69·9	47·3	59·6	963·6
1935	455·8	128·8	10·0	7·6	26·9	11·2	52·3	62·9	25·4	57·6	37·6	57·6	933·7
1936	175·4	−6·8	14·4	9·6	27·9	8·8	56·8	71·8	16·0	61·7	31·0	63·9	830·5
1937	592·4	92·4	19·2	15·0	36·1	13·1	59·9	98·2	24·0	62·2	27·4	69·1	1,109·0

difficulty in arriving at the dry rubber content, the export figures for some of the earlier years, in some of the countries, may not have been quite complete. Furthermore, losses have occurred in transit, especially during the War. In the import figures in the earlier years many countries included gutta percha, Balata, scrap rubber, and occasionally manufactured rubber goods, and in cases where the re-exports were small they were generally not separately distinguished. Gross weights have occasionally been entered instead of net weights. These errors do not amount to a high percentage of the total exports or total imports in any one year, and the figures given in the tables indicate fairly accurately the general development of the rubber industry during the earlier period.

V. ABSORPTION

By absorption of rubber is meant the quantity of crude rubber turned into manufactured rubber goods. Data of this nature are available for the United States and, from 1935, for the United Kingdom.

The United States data have been issued regularly only since 1920, although figures for 1917 are available as the result of a special census. They are based on returns made to the Rubber Manufacturers' Association by members representing between 80 and 90 per cent. of the total United States absorption. The Rubber Manufacturers' Association data are reviewed annually by the Rubber Division of the United States Department of Commerce, and the final annual figures, which include the comparatively small absorption of rubber by industries which are not classed as rubber-manufacturing industries, are about as reliable as it is possible to obtain.

In the absence of specific data for absorption the figures for net imports have to be used. In the case of the United Kingdom, the stocks in the public warehouses in London and Liverpool show considerable fluctuations, but these stocks are known accurately at the end of each month, and the net import figures can be adjusted to allow for their variations. When the adjustment is made, the resulting figure represents the crude rubber delivered to manufacturers, and this gives a much closer approximation to the absorption in the United Kingdom than is given by net imports alone. Since the beginning of 1935, however, estimates of absorption by manufacturers in the United Kingdom at the end of each quarter have been made available. (Since October 1937 these estimates have been supplied monthly.)

For all the remaining manufacturing countries the absorption is measured by their net imports. Very little stock data are available, but the stocks in any of those countries probably do not normally show large variations from one year to another, and in the years when considerable changes in the stocks have taken place these changes are obvious in the import figures. Thus during 1928 stocks in most countries were reduced in anticipation of the removal of the Stevenson Scheme on October 31st of that year, and in the following year they were replenished. Hence, their 1928 figures for net imports under-stated their 1928 absorption, and their 1929 figures over-stated their 1929 absorption. This applies also to the deliveries to manufacturers in the United Kingdom. The total adjustment probably amounted to between 15,000 and 20,000 tons. During the

TABLE VII

Absorption of Rubber, 1910-37

(In 1,000 tons)

Year	United States of America				United Kingdom (5)	Europe (6)	Other Manufacturing Countries (7)	Producing Countries (8)	Total (9)
	Automobile Tyres and Tubes (1)	Other Tyres (2)	Other Goods (3)	Total (4)					
1910	—	—	—	39	19	34	2	—	94
1911	—	—	—	40	18	37	3	—	98
1912	—	—	—	50	17	41	4	—	112
1913	—	—	—	53	25	49	4	—	131
1914	—	—	—	60	17	38	3	—	118
1915	—	—	—	95	15	41	6	—	157
1916	—	—	—	115	23	37	8	—	183
1917	110		47	157	20	35	9	—	221
1918	—	—	—	140	31	28	17	—	216
1919	—	—	—	225	36	49	17	—	327
1920	—	—	—	215	24	51	20	—	310
1921	125	13	32	170	18	50	31	—	269
1922	206	26	53	285	10	67	27	1	390
1923	220	25	60	305	27	70	32	1	435
1924	257	22	56	335	23	76	38	1	473
1925	299	27	62	388	30	100	38	2	558
1926	289	24	53	366	39	90	49	2	546
1927	295	22	56	373	45	121	58	2	599
1928	352	22	63	437	49	124	68	2	680
1929	376	18	73	467	72	177	90	3	809
1930	298	12	66	376	75	191	71	2	715
1931	281	9	65	355	77	166	86	2	686
1932	264	8	65	337	78	173	101	3	692
1933	309	10	90	409	79	214	115	4	821
1934	351	13	98	462	90	239	128	3	922
1935	364	14	111	489	95	236	113	4	937
1936	428	15	132	575	99	233	129	8	1,044
1937	390*	16*	137*	543	115	281	143	10	1,092

* Estimates.

last quarter of 1930 rubber was rushed into France in anticipation of an import duty, and the French imports during that quarter were probably about 15,000 tons higher than their absorption. During the latter part of 1933 and the first half of 1934 stocks were increased in anticipation of the introduction of the regulation scheme.

The figures for all these countries, however, and those for the United Kingdom up to 1934, do include the increase in working stocks necessary for an expanding industry. In other words, they over-state somewhat their true annual absorption.

A summary of the total world absorption since 1910 is given in Table VII. It is not possible to adjust individual figures in this table to allow for moisture and impurities in the wild rubber which, in the earlier years, formed a large, but rapidly diminishing, propor-

TABLE VIII

Automobile Registration

(In 1,000 Vehicles)

Year	United States of America			Other Countries			Total		
	Passenger Cars (1)	Trucks and Buses (2)	Total (3)	Passenger Cars (4)	Trucks and Buses (5)	Total (6)	Passenger Cars (7)	Trucks and Buses (8)	Total (9)
1910	459	10	469	—	—	—	—	—	—
1911	620	20	640	—	—	—	—	—	—
1912	903	41	944	—	—	—	—	—	—
1913	1,194	64	1,258	—	—	—	—	—	—
1914	1,625	86	1,711	—	—	—	—	—	—
1915	2,328	136	2,464	—	—	—	—	—	—
1916	3,390	215	3,605	—	—	—	—	—	—
1917	4,763	326	5,089	—	—	—	—	—	—
1918	5,622	525	6,147	—	—	—	—	—	—
1919	6,771	794	7,565	—	—	1,287	—	—	—
1920	8,155	1,077	9,232	—	—	1,711	—	—	—
1921	9,279	1,184	10,463	—	—	2,191	—	—	—
1922	10,750	1,488	12,238	1,969	465	2,434	12,719	1,953	14,672
1923	13,291	1,801	15,092	2,383	548	2,931	15,674	2,349	18,023
1924	15,506	2,131	17,637	3,006	710	3,716	18,512	2,841	21,353
1925	17,609	2,442	20,051	3,448	1,090	4,538	21,057	3,532	24,589
1926	19,373	2,764	22,137	4,227	1,286	5,513	23,600	4,050	27,650
1927	20,365	2,897	23,262	4,963	1,462	6,425	25,328	4,359	29,687
1928	21,516	3,114	24,630	5,612	1,793	7,405	27,128	4,907	32,035
1929	23,273	3,380	26,653	6,394	2,080	8,474	29,667	5,460	35,127
1930	23,233	3,486	26,719	6,838	2,270	9,108	30,071	5,756	35,827
1931	22,538	3,467	26,005	6,844	2,433	9,277	29,382	5,900	35,282
1932	21,066	3,229	24,295	6,831	2,420	9,251	27,897	5,649	33,546
1933	20,830	3,227	24,057	7,076	2,429	9,505	27,906	5,656	33,562
1934	21,744	3,419	25,163	7,477	2,715	10,192	29,221	6,134	35,355
1935	22,801	3,647	26,448	8,122	2,950	11,072	30,923	6,597	37,520
1936	24,246	4,024	28,270	8,807	3,258	12,065	33,053	7,282	40,335
1937	25,460	4,195	29,655	9,200	3,600	12,800	34,660	7,795	42,455

tion of the total exports, but it is only in the years 1910–15 that those adjustments are of any importance.

Approximately two-thirds of the annual absorption of rubber is utilized in the manufacture of automobile tyres and tubes. The remainder goes into a very large number of other uses, of which the most important are mechanical rubber goods, footwear, insulation materials, and bicycle tyres.

The United States is the only country for which it is possible, at present, to make an approximate division of annual absorption between automobile tyres and other goods. The distribution of the total absorption in the United States for each year, on the basis of these data, may rather under-state the absorption in other uses. The steady decrease in absorption in "Other tyres," until 1932,

TABLE IX

Automobile Output

(In 1,000 Vehicles)

Year	United States of America			Other Countries			Total		
	Passenger Cars (1)	Trucks and Buses (2)	Total (3)	Passenger Cars (4)	Trucks and Buses (5)	Total (6)	Passenger Cars (7)	Trucks and Buses (8)	Total (9)
1910 ...	181	6	187	—	—	—	—	—	—
1911 ...	199	11	210	—	—	—	—	—	—
1912 ...	356	22	378	—	—	—	—	—	—
1913 ...	461	24	485	—	—	—	—	—	—
1914 ...	544	25	569	—	—	—	—	—	—
1915 ...	896	74	970	—	—	—	—	—	—
1916 ...	1,526	92	1,618	—	—	—	—	—	—
1917 ...	1,746	128	1,874	—	—	—	—	—	—
1918 ...	944	227	1,171	—	—	—	—	—	—
1919 ...	1,658	276	1,934	—	—	—	—	—	—
1920 ...	1,905	322	2,227	—	—	—	—	—	—
1921 ...	1,442	155	1,597	—	—	—	—	—	—
1922 ...	2,274	270	2,544	—	—	—	—	—	—
1923 ..	3,625	409	4,034	—	—	—	—	—	—
1924 ...	3.186	417	3,603	—	—	494	—	—	4,097
1925 ...	3,735	531	4,266	—	—	612	—	—	4,878
1926 ...	3,784	517	4,301	587	123	710	4,371	640	5,011
1927 ...	2,936	465	3,401	618	156	774	3,554	621	4,175
1928 ...	3,816	543	4,359	668	177	845	4,484	720	5,204
1929 ...	4,587	771	5,358	705	214	919	5,292	985	6,277
1930 ...	2,785	571	3,356	586	184	770	3,371	755	4,126
1931 ...	1,973	417	2,390	502	157	659	2,475	574	3,049
1932 ...	1,136	235	1,371	461	145	606	1,597	380	1,977
1933 ...	1,573	347	1,920	582	174	756	2,155	521	2,676
1934 ...	2,178	575	2,753	746	237	983	2,924	812	3,736
1935 ...	3,252	695	3,947	896	285	1,181	4,148	980	5,128
1936 ...	3,669	785	4,454	989	373	1,362	4,658	1,158	5,816
1937 ...	3,916	894	4,810	1,094	449	1,543	5,010	1,343	6,353

was mainly due to the replacement of solid tyres by pneumatics on heavy vehicles; the increase since 1932 appears to have been due to increased sales of re-treading material. About 75 per cent. of the annual absorption in the United States has, in recent years, gone into the manufacture of automobile tyres and tubes (including solid tyres); in earlier years the percentage has been higher. The proportion of the total absorption of Other Countries utilized in the manufacture of automobile tyres is unknown, but is probably in the neighbourhood of 60 per cent.

Most of the data for the automobile industry are published in the annual reports of the Automobile Manufacturers' Association of the United States,[2] which in return receives much information from the Automotive Division of the United States Department of Commerce. The data on registration and output of automobiles are given in Tables VIII and IX.

The registration of all classes of automobiles, both in the United States and in Other Countries, increased continuously up to 1929. During the depression years 1930–33 passenger-car registration decreased by over 10 per cent. in the United States and remained stationary in Other Countries; truck and bus registration declined slightly in the United States and increased in Other Countries. From 1933 to 1936 a substantial increase has occurred in both classes of vehicles, and in every country. Except for passenger cars in the United States, the great depression did not result in any

TABLE X

Age Distribution of Automobiles Registered in the United States of America, 1920–36—*Passenger Cars*

(In 1,000 Vehicles)

Year	Numbers Registered during Year (1)	Numbers Registered at Different Ages, assuming that the Oldest Cars are First Eliminated									
		0–1 (2)	1–2 (3)	2–3 (4)	3–4 (5)	4–5 (6)	5–6 (7)	6–7 (8)	7–8 (9)	8–9 (10)	9–10 (11)
1920	8,155	1,759	1,589	905	1,677	1,462	763	—	—	-	—
1921	9,279	1,394	1,759	1,589	905	1,677	1,462	493	—	—	—
1922	10,750	2,170	1,394	1,759	1,589	905	1,677	1,256	—	—	-
1923	13,291	3,439	2,170	1,394	1,759	1,589	905	1,677	358	—	—
1924	15,506	2,959	3,439	2,170	1,394	1,759	1,589	905	1,291	—	—
1925	17,609	3,414	2,959	3,439	2,170	1,394	1,759	1,589	885	—	—
1926	19,373	3,491	3,414	2,959	3,439	2,170	1,394	1,759	747	—	—
1927	20,365	2,605	3,491	3,414	2,959	3,439	2,170	1,394	893	—	—
1928	21,516	3,397	2,605	3,491	3,414	2,959	3,439	2,170	41	—	—
1929	23,273	4,138	3,397	2,605	3,491	3,414	2,959	3,269	—	—	—
1930	23,233	2,538	4,138	3,397	2,605	3,491	3,414	2,959	691	—	—
1931	22,538	1,840	2,538	4,138	3,397	2,605	3,491	3,414	1,115	—	—
1932	21,066	1,064	1,840	2,538	4,138	3,397	2,605	3,491	1,993	—	—
1933	20,830	1,476	1,064	1,840	2,538	4,138	3,397	2,605	3,491	281	—
1934	21,744	1,995	1,476	1,064	1,840	2,538	4,138	3,397	2,605	2,691	—
1935	22,801	3,043	1,995	1,476	1,064	1,840	2,538	4,138	3,397	2,605	705
1936	21,246	3,459	3,043	1,995	1,476	1,064	1,840	2,538	4,138	3,397	1,296

actual decline in the registration of motor vehicles; it merely retarded its growth. The effect of the depression was, however, reflected in automobile output, and, as shown in Table IX, severe declines occurred in both classes of vehicles both in the United States and in Other Countries. The explanation of this apparent anomaly is indicated in Tables X and XI, where an attempt has been made to indicate, roughly, the life of a car and of a truck and bus in the United States during the past sixteen years. These tables are based (1) on the annual registration figures, (2) on the number of vehicles available for domestic use each year, and (3) on the assumption that the oldest vehicles are the first to be eliminated. The increase in the life of automobiles, from 1929 to 1933, was to a large extent due to replacement being postponed; but this was not the sole reason, for the improvement in the quality of automobiles produced during the last ten or fifteen years has itself effected a steady increase in the average life. This is perhaps more clearly indicated in Table XII, Columns 9 and 10, which give approximately the average age of vehicles in the United States, and probably explains the persistence of the older vehicles in 1936, when the trade conditions were improving.

TABLE XI

Age Distribution of Automobiles Registered in the United States of America, 1920–36—Trucks and Buses

(In 1,000 Vehicles)

Year	Numbers Registered during Year	Numbers Registered at Different Ages, assuming that the Oldest Trucks are First Eliminated										
		0–1	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10	10 and over
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1920	1,077	292	260	217	113	73	52	22	23	22	3	—
1921	1,184	143	292	260	217	113	73	52	22	12	—	—
1922	1,488	248	143	292	260	217	113	73	52	22	23	45
1923	1,801	361	248	143	292	260	217	113	73	52	22	21
1924	2,131	351	361	248	143	292	260	217	113	73	52	21
1925	2,442	421	351	361	248	143	292	260	217	113	33	—
1926	2,764	418	424	351	361	248	143	292	260	217	50	—
1927	2,897	331	418	424	351	361	248	143	292	260	69	—
1928	3,114	380	331	418	421	351	361	248	143	292	166	—
1929	3,380	489	380	331	418	424	351	361	248	143	235	—
1930	3,486	413	489	380	331	418	424	351	361	248	71	—
1931	3,467	309	413	489	380	331	418	424	351	352	—	—
1932	3,229	188	309	413	489	380	331	418	424	277	—	—
1933	3,227	269	188	309	413	489	380	331	418	424	6	—
1934	3,419	449	269	188	309	413	489	380	331	418	173	—
1935	3,647	571	449	269	188	309	413	489	380	331	248	—
1936	4,024	650	571	449	269	188	309	413	489	380	306	—

Another important feature shown in Table VIII is the proportion which the heavy motor transport (trucks and buses) bears to the total registration, for heavy motor transport satisfies more funda-

TABLE XII

Data Relating to the Absorption of Rubber in the United States

Year	Output of Automobile		Manufacturers' Inventory of Automobile		Average Replacement Sales. Casings per Re-registered Automobile	Crude Rubber Content in Manufacturers' Inventory of Casings and Tubes	Average Quantity of Crude Rubber in Casing and Tube	Average Absorption per Registered Automobile	Average Age of Automobiles	
	Casings (1)	Tubes (2)	Casings (3)	Tubes (4)	(5)	(6)	(7)	(8)	Passenger Cars (9)	Trucks and Buses (10)
	1,000's	1,000's	1,000's	1,000's		1,000 tons	Lbs.	Lbs.	Years	Years
1921	29,093	36,135	4,929	6,308	2·7	22·9	9·9	31·1	3·2	2·9
1922	40,930	50,848	6,132	7,643	3·1	31·5	11·0	39·5	3·2	3·6
1923	45,258	60,114	5,772	8,124	2·7	28·9	10·4	35·5	3·0	3·6
1924	51,632	70,704	7,427	11,052	2·5	38·7	10·8	33·5	3·2	3·8
1925	60,842	82,613	8,142	11,313	2·6	41·9	10·8	35·0	3·1	3·8
1926	61,470	76,617	10,456	16,200	2·2	52·8	10·1	29·7	3·1	4·0
1927	63,550	70,855	10,312	13,692	2·4	49·4	10·2	29·3	3·4	4·2
1928	76,647	80,810	13,624	16,117	2·6	63·9	10·2	31·5	3·4	4·3
1929	69,765	71,013	11,838	12,807	2·2	61·1	12·0	32·7	3·4	4·3
1930	51,735	56,390	9,003	9,999	1·7	52·0	12·7	26·2	3·6	4·3
1931	49,143	49,167	7,775	7,922	1·7	41·6	12·8	24·8	3·9	4·5
1932	40,418	37,530	7,641	6,749	1·5	19·6	14·8	21·6	4·3	4·7
1933	45,376	42,904	8,888	7,815	1·6	59·9	15·4	28·2	4·7	4·9
1934	47,233	46,228	9,455	9,180	1·6	70·2	16·7	31·4	5·1	4·9
1935	48,482	47,761	8,196	8,231	1·5	61·8	16·9	32·5	5·1	4·7
1936	58,117	57,247	11,111	10,985	1·5	81·9	16·5	33·0	5·0	4·5
1937	55,402	52,342	10,776	10,056	1·4	—	—	—	4·8	4·2

mental needs and is a steadier, and relatively greater, consumer of rubber. In the United States this proportion has increased from 11 per cent. in 1920 to 14 per cent. in 1936. In Other Countries the proportion has always been nearly twice as high, and has increased from about 20 per cent. in 1922 to 27 per cent. in 1936. The difference is largely due to the higher standard of living in the United States.

The distribution of motor transport throughout the world depends generally on the state of economic development in the various countries, and this in turn affects the mileage of roads available for motor transport. The number of inhabitants per automobile varies from 4½ in the United States to 10,000 in China, and averages about 160 for all countries, excluding the United States. The numbers for the more important countries during 1936 were :—

United States	4½	United Kingdom ...	21
New Zealand	7	Union of South Africa ...	31
Canada	9	Sweden	37
Australia	10	Belgium	41
France	19	Germany	49

In the Union of Soviet Socialist Republics, where development is proceeding fairly rapidly, the number was still as high as 479.

Continuous improvement has also been effected in the life of tyres. In the case of first-line tyres the average mileage obtained has increased from about 4,000 to 5,000 in 1921 to something like 20,000 or more to-day. This is reflected in the steady decrease in the replacement sales per re-registered vehicle. But the drop in these sales between 1925 and 1926 and again between 1928 and 1932, shown in Table XII, Column 5, cannot be explained entirely by improved construction, and there is little doubt that the depression brought about the utilization of much tyre mileage which in more prosperous days would have gone into the scrap-heap. The replacement tyre sales per vehicle have not increased much since 1933, and this may be largely due to the fact that a casing and tube now contain over 60 per cent. more crude rubber than in 1929. As shown in Table XII, Column 7, the average quantity of crude rubber in a casing and tube remained fairly steady until 1930, and thereafter increased continuously until 1935. The tendency in motor transport in recent years has been towards high-powered vehicles with higher speeds (speed is an important factor in tyre wear), more rapid acceleration, more efficient braking and rougher road surfaces, and this, together with the change-over from solids to pneumatics in heavy vehicles, largely explains the increase in the rubber requirement in tyres.

The decline in the total output of tyres in the United States during the great depression, shown in Table XII, Columns 1 and 2, was therefore due to: (1) the decline in original equipment because automobiles were made to run longer, (2) the decline in replacement because the tyres then in use were made to run longer, (3) the decline in manufacturers' stocks, (4) the improved quality of the tyres (which was compensated for by the higher rubber content).

The effect of the depression is also seen from a somewhat different angle in Table XII, Column 8, where an approximate estimate has been made of the absorption of rubber per registered automobile in the United States. The figures in this column have been deduced from the total annual absorption in automobile tyres (including solids) adjusted for the exports of tyres, for changes in tyre inventories and for the estimated quantity of rubber used in other parts of an automobile. The figures are only approximate, but they indicate the trend clearly enough.

The increase in the absorption in goods other than automobile tyres from about 40,000 tons in 1910 to nearly 100,000 tons in 1920 and to about 350,000 tons in 1937 has been largely due to the steady development of new uses for the commodity. The widespread nature of these uses and their continuous growth in numbers helped to maintain the crude rubber requirements of "Other Goods" during the depression.

It is thus largely because of its dependence on motor transport that rubber is susceptible to trade fluctuations, for in times of prosperity automobiles and tyres are scrapped earlier than in times of depression. During the depression years the decrease in the annual absorption of crude rubber has taken place entirely in the United States, and, within that country, mainly in the rubber absorbed in automobile tyres and tubes. The small decrease in the absorption in other goods was also, to some extent, accounted for by the decline in the output of automobiles during this period, for considerable quantities of crude rubber are now used in automobiles apart from tyres and tubes.

When allowance is made for the replenishment of stocks, which took place during 1929 in countries other than the United States, and for the 15,000 tons additional rubber which were rushed into France in 1930, in anticipation of an import duty, it is clear that during the years 1929–32 the absorption of the United Kingdom and

TABLE XIII

Declared Stocks Inside Existing Regulated Areas

(At end of year.)

	1934 (1)	1935 (2)	1936 (3)	1937 (4)
	Tons	Tons	Tons	Tons
Estate Stocks.				
Malaya	12,500	23,434	26,044	24,488
Netherlands East Indies	6,607	17,407	10,298	20,665
Ceylon	3,000	3,823	3,190	4,979
India *	1,000	1,150	1,500	1,750
British North Borneo	749	546	868	831
Sarawak	144	150	238	181
French Indo China	1,500	2,246	1,064	4,365
Total	25,500	48,756	43,202	57,259
Dealers' Stocks.				
Malaya	16,440	10,465	9,101	21,246
Netherlands East Indies, Estate ...	4,913	5,010	3,641	6,388
,, ,, ,, Native ...	16,453	5,987	7,539	13,758
Ceylon	6,804	4,794	5,161	5,632
India	1,000	1,150	2,550	3,500
British North Borneo	63	22	16	22
Sarawak	820	988	2,498	1,290
French Indo China	165	40	134	1,598
Total	46,658	28,456	30,640	53,434
GRAND TOTAL	72,158	77,212	73,842	110,693

No data are available for Burma or Siam.

* Includes Stocks on Small Holdings.

the Continent of Europe increased steadily, if rather slowly, and that of the remaining manufacturing countries increased more rapidly. Nevertheless the rate of growth of those groups was below its pre-depression value. When economic conditions began to improve, the absorption of every country has shown a rapid increase, the total increase from 1932 to 1937 being in the neighbourhood of 50 per cent.

VI. STOCKS

The world's stocks may be conveniently divided into three categories:—

1. *Stocks in Producing Countries.*
2. *Quantities Afloat.*
3. *Stocks in Manufacturing Countries.*

The important stock figures are given in Tables XIII and XV.

TABLE XIV

Stock Ratios Producing Countries, 1936–37

Period		Ratio of Estate Stocks at end of month to Estate Output during month		Ratio of Dealers' Stocks at end of month to Native Output during month		Ratio of Singapore and Penang Stocks at end of month to Gross Malayan Exports during month (5)
		Malaya (1)	Netherlands East Indies (2)	Malaya (3)	Netherlands East Indies (4)	
1936	January ...	1·03	1·23	1·10	0·72	0·80
	February ...	1·16	1·25	1·44	0·36	1·00
	March	1·40	1·63	1·26	0·59	0·63
	April	1·16	1·34	1·27	0·49	0·89
	May	1·12	1·25	1·56	0·56	0·57
	June	1·09	1·17	1·29	0·44	0·71
	July	1·02	0·94	0·91	0·34	0·56
	August ...	1·01	1·00	1·32	0·53	0·65
	September ...	1·09	1·00	1·10	0·67	0·61
	October ...	1·04	0·78	0·84	0·58	0·53
	November ...	1·09	0·80	1·15	0·37	0·57
	December ...	1·12	0·64	0·94	0·71	0·70
1937	January ...	1·01	0·70	1·11	0·55	0·87
	February ...	1·12	0·76	1·56	0·59	1·11
	March	1·11	0·65	0·97	0·46	0·71
	April	1·06	0·70	1·38	0·63	0·66
	May	1·01	0·74	1·47	0·50	0·67
	June	0·91	0·67	0·98	0·49	0·82
	July	0·93	0·80	1·27	0·49	0·62
	August ...	0·89	1·05	0·98	0·47	0·74
	September ...	0·91	1·03	0·71	0·50	0·73
	October ...	0·93	0·97	1·20	0·72	0·71
	November ...	0·97	1·04	1·19	0·96	0·67
	December ...	0·83	1·07	1·03	1·16	0·79

TABLE XV

Declared Stocks at End of Each Year Outside Existing Regulated Areas, 1920–37

Year	Singapore and Penang Dealers' and Port Stocks (1)	Para and Manaos (2)	Afloat (3)	United Kingdom Public Warehouses London and Liverpool (4)	United States of America Manufacturers, Dealers, Importers, etc. (5)	Total (6)	World Absorption (7)	Ratio of Total Stocks to Average Monthly World Absorption during Year. (8)	Ratio of United Kingdom Stocks to Average Monthly World Absorption during Year (9)	Ratio of United States Stocks to Average Monthly United States Absorption (10)
	1,000 tons	1,000 tons	1,000 tons	1,000 tons	1,000 tons	1,000 tons	1,000 tons			
1920	N.A.	N.A.	N.A.	56	N.A.	—	310	*9·0*	2·2	—
1921	N.A.	N.A.	N.A.	80	100	—	269	*12·0*	3·6	7·1
1922	N.A.	N.A.	N.A.	81	90	—	390	*8·0*	2·5	3·8
1923	36	3	50	67	73	229	435	6·3	1·8	2·9
1924	21	2	53	32	55	163	473	4·2	0·8	2·0
1925	23	2	65	6	51	147	558	3·2	0·1	1·6
1926	30	3	77	51	73	231	546	5·1	1·1	2·4
1927	27	3	67	66	99	262	599	5·3	1·3	3·2
1928	37	4	118	23	65	247	680	4·1	0·4	1·8
1929	37	4	96	73	119	329	809	4·9	1·1	3·1
1930	42	5	87	119	201	451	715	7·6	2·0	6·4
1931	50	6	85	127	322	590	686	10·3	2·2	10·9
1932	31	6	81	93	379	590	692	10·2	1·6	13·5
1933	45	3	117	87	368	620	821	9·0	1·3	10·8
1934	62	3	126	135	361	687	922	8·9	1·8	9·4
1935	28	5	86	164	312	595	937	7·6	2·1	7·7
1936	27	2	103	78	223	433	1,044	5·0	0·9	4·7
1937	45	2	135	58	257	497	1,092	5·5	0·6	5·7

N.A. = not available.

(a) *Stocks in producing countries.*

While the regulation scheme is in operation those stocks must be divided into two sections: (1) those inside the regulated areas, and (2) those outside.

The stocks inside the regulated areas can be exported only as part of the permissible exports from those countries. In these stocks I have included the stocks in French Indo China, which belong naturally to this category; in any case they are not very important. These stocks consist of stocks on estates, stocks on native holdings, stocks in the hands of dealers and quantities in transit. Estate stocks in Malaya have been published, monthly, since 1928, but the estate stocks in other countries have been available only since the introduction of the regulation scheme in 1934. Except for Malaya, which includes rubber in course of preparation, the estate stocks generally consist of rubber ready for dispatch. Stocks of ready rubber on estates in Malaya, the Netherlands East Indies and probably also in other countries, average about three-quarters of a month's output (see Table XIV). Fluctuations about this average are mainly incidental to the working of the regulation scheme, and in any case are not generally important. A considerable deviation occurred, however, in the Netherlands East Indies during the first half of 1936, and was due to the purchase, by the Netherlands East Indies Government, in 1935, of estate export rights equivalent to 20,000 tons of rubber to offset the over-exports of their native rubber. The rubber accumulated on estates during the last quarter of 1935, and owing to the somewhat tardy issue of export rights during the early part of 1936 these stocks were only slowly brought down to a normal level.

There are no data on stocks on native holdings, but native producers normally carry little stock. Their sheets or coagulum are sold to a local dealer as soon as they are ready. Occasionally, on a sudden drop in price, rubber accumulates on native holdings in the Netherlands East Indies, partly because the natives are unwilling to sell, and partly because the local dealers are unwilling to buy, since, by the time they get this rubber to Singapore, the price may have gone further against them. When the price becomes stabilized at a lower level, these accumulations are exported. The stocks carried by native producers probably average less than a week's output.

Dealers' stocks in Malaya (except those in Singapore and Penang, which are outside the regulated areas) consist mainly, although not entirely, of native rubber; in the Netherlands East Indies separate figures for estate and native dealers' stocks are available; for the remaining countries no distinction is made. The dealers' stocks of native rubber show more variation in relation to the monthly output of native rubber than the corresponding variation of stocks on estates (see Table XIV), but there is always some margin of error in the native output figures, and the ratio is still fairly steady. The variations, both in stocks and output, are mainly due to the working of a regulation scheme.

Producers' and dealers' stocks, therefore, represent merely the necessary working stocks of their industry, and their magnitude normally depends on the rate of output.

No data are available on quantities in transit inside producing countries, but, unless rubber is rushed out of the regulated areas in order to prevent the cancellation of export licences, or for some similar reason, it is unlikely that the ratio of the quantities in transit to the monthly output or exports shows much variation.

The stocks outside the regulated areas consist of the dealers' and port stocks in Singapore and Penang and the comparatively unimportant stocks in Para and Manaos.

Singapore is an important rubber market, and acts as a collecting and distributing depot for considerable quantities of rubber produced in the neighbouring countries. The stocks in Singapore and Penang, at the end of each month, average nearly three-quarters of the gross exports from Malaya during the same month. Deviations from this average appear to be mainly due to clearances of shipping.

Rubber deteriorates if stored for any length of time in the East, and stocks are never likely to accumulate in producing countries. Temporary accumulations have taken place in very abnormal circumstances. About 75,000 tons in excess of their working stocks were accumulated in Malaya and Ceylon before the removal of the Stevenson Scheme on October 31st, 1928, although the stocks in Singapore and Penang, which were free ports, fell to 12,000 tons. Again, just before the existing scheme was introduced on June 1st, 1934, stocks inside the regulated areas were reduced to an unworkable level and had to be replenished before the full permissible exports could take place, while the stocks in Singapore and Penang, and in the hands of the customs authorities in the regulated areas of Malaya, increased to 95,000 tons—50,000 tons higher than at the end of 1933. On each occasion the stocks, both inside and outside the regulating areas, reverted in time to the level appropriate to the rate of output or export. The reason for rushing rubber outside the regulated areas before the scheme came into force was, of course, that such rubber would not be included as part of the permissible exports under the scheme.

Stocks in producing countries, therefore, are likely to maintain a fairly steady ratio to their rate of output. Under the International Agreement each producer, estate or native, can carry stocks of ready rubber up to the equivalent of two months' permissible exports, and dealers' stocks, except those in Singapore and Penang, may not exceed one and a half months' permissible exports. These limits have never been reached, and at the end of 1937 the total stocks of ready rubber were not much in excess of one-third of the maximum permitted.

(b) *The quantity afloat.*

By quantity afloat is meant rubber which has been declared as an export from the exporting countries but has not yet been declared as an import into the importing countries. Exact data on quantities afloat are not available, but they obviously depend on the rate of exports, and experience has shown that the quantity afloat at the end of any month may be measured roughly by the exports from producing countries during that month, together with one-third of the exports during the previous month.

Apart from exceptional conditions due to the introduction or working of a regulation scheme, the total stocks in these two categories represent working stocks, and contain rubber surplus to the world's requirements only to the extent that the monthly rate of output exceeds the monthly rate of absorption.

(c) *Stocks in manufacturing countries.*

Complete and reliable data for stocks in manufacturing countries are available only for the United States and for the United Kingdom.

In the United States, the Rubber Manufacturers' Association publishes each month estimates of the stocks in the hands of manufacturers and the stocks in the hands of dealers. These estimates are based on the returns made to the Association by rubber dealers and by manufacturers representing from 80 to 90 per cent. of the total United States absorption. The estimates are not always accurate, because some rubber may be held by speculative interests for which no return is made. Finally the whole stock position is reviewed at the end of each year by the United States Department of Commerce. As the stocks held by dealers in the United States sooner or later find their way into the factories, and a large proportion of them is held against forward sales to those factories, the stocks of manufacturers and dealers may be considered together. Figures of stocks are meaningless unless they are compared with the rate of absorption, and the ratio of the stocks at the end of each year to the average monthly absorption during that year is given in Table XV, Column 10. This ratio has shown very considerable variation during the past fifteen years, and if the stocks at the end of each month were compared with the absorption during that month the variation would have been greater still. It may seem strange that, in the years 1929–32, when trade in the United States, and, with it, their absorption of rubber, was steadily declining, so much rubber should have accumulated in that country. At the end of 1932 their stocks were equivalent to 13·5 months' absorption. The main reason is, I think, that when these stocks were purchased, frequently on a forward contract, the price paid for them was below the cost of production at the date of purchase, and no one during those years foresaw the sacrifices that those engaged in the rubber-producing industry could make when, with its back to the wall, it was struggling for existence.

In the United Kingdom the important stocks are those in the public warehouses in London and Liverpool. These stocks, about 85 per cent. of which is in the form of standard grades, are accurately known at the end of each week and at the end of each calendar month. Data for stocks in the hands of manufacturers in the United Kingdom have become available only since the end of 1934, and until September 1937 were given at the end of each quarter; since then monthly figures have been made available. A comparatively small proportion, generally less than 10 per cent. of the London and Liverpool stocks, represents producers' rubber awaiting sale; the remainder is held by dealers. The dealers' stocks are mainly held against forward sales to manufacturers and to speculators. The stocks in the public warehouses in London and Liverpool represent the world's ultimate reserve of crude rubber. It is to these warehouses that rubber gravitates when it cannot find a purchaser elsewhere, and it is from these warehouses that the trade obtains additional rubber when, at any time, output is below absorption.

London is the principal world market for rubber, and its financial facilities for carrying rubber are more developed than elsewhere. The market is highly organized, and the public warehouses offer ample storage and sampling facilities. Although no important country, except Russia, and occasionally Germany, normally draws any significant part of its supplies from the United Kingdom, a considerable part of the annual world requirements are purchased through London and shipped direct to manufacturing countries; the magnitude of the United Kingdom stocks should therefore be measured against the current world absorption. The ratio of these stocks at the end of each year to the average monthly world absorption during that year is given in Table XV, Column 9. The ratio has also shown considerable fluctuations during the past seventeen years.

No other country publishes complete and reliable figures of stocks of crude rubber. Certain data for stocks in Japan have been published, but a recent census in that country has shown that the figures are incomplete. There are no important rubber markets in any of these countries, and therefore their dealers' stocks are insignificant. Variation in their stocks in past years has been due to anticipation of the removal or introduction of a regulating scheme, or of the introduction of an import duty, or to the building up of a war stock. It is likely that the total stocks in these countries normally bear a fairly definite ratio to their rate of absorption, although the size of that ratio is, of course, largely guesswork. An examination of the import figures of these countries usually gives some guidance in estimating their stock movements.

The distribution of stocks amongst the various manufacturers of the world is also of some importance. It seems likely that the majority of the small and medium-sized factories do not carry much more than their necessary working stocks. The large manufacturers, probably because of their greater commitments, must look further ahead and carry considerable stocks in addition to varying quantities of forward purchases. It would seem, therefore, that a great part of the rubber surplus to the necessary manufacturing requirements is in the hands of the larger manufacturers. The four big American manufacturers and one big British manufacturer are believed to account, between them, for nearly half the total world absorption, although the buying of crude rubber by these five companies is competitive.

(d) *Normal Stocks.*

The question as to what constitutes a normal stock has been frequently discussed, but it does not admit of a satisfactory solution. Stocks, as already pointed out, have to be measured in terms of months' absorption, but in times of speculative activity it is the total demand that is important, and that demand cannot be even approximately measured.

The ratio of the total declared stocks outside the existing regulated areas at the end of each year to the average monthly absorption during that year is given in Table XV, Column 8. This ratio has varied from 3·2 at the end of 1925 to 10·3 at the end of 1931, and the ratio of the stocks at the end of each month to the absorption during that month has shown greater variation. Yet throughout the whole of this period, except during 1925, the stocks have been ample for all requirements. At the end of September 1928—one month before the removal of the Stevenson Scheme—the ratio was 3·2. The price, however, was only 8½*d.* per lb., as large stocks were accumulated in Malaya and Ceylon. Examination of past data, therefore, is not much help in arriving at a definition of a normal stock, if by normal stock is meant such a stock as would prevent undue fluctuations in price and at the same time maintain a reasonable price, and the reason is, that the level of stocks cannot be considered apart from future prospects. In any case, a regulation scheme, one of the declared objects of which is to maintain a reasonable price, cannot work to a rigid ratio of absorption to stocks even if it were physically possible to maintain a constant ratio.

If there were no interruption to the steady flow of supplies, or to the steady flow of absorption (seasonal influences being allowed for), there would seem to be little need for manufacturers to carry more than a month's requirements in their warehouses. In addition, a total stock of probably one month's world absorption might have to be carried in the United Kingdom and the United States as a market stock and a reserve for contingencies. If production and absorption were balanced, the quantity afloat and the stocks in Singapore and Penang would be about two months' absorption. Thus the total world stocks outside the regulated areas would not be more than the equivalent of four months' absorption. Such conditions do not exist in the rubber industry. Apart from the possibility of interruption to the free flow of supplies, caused by an outbreak of war, there are the more likely interruptions due to speculative activity, and manufacturing activity in the United States is subject to sudden changes of considerable magnitude.

Rubber is a commodity which is well adapted to speculative activity. Nearly half the output is in standard grades, and it can be stored indefinitely in temperate climates. Hence, in order to protect themselves against undue competition from the speculator, manufacturers, especially the large manufacturers, must carry stocks considerably in excess of their minimum requirements. The speculator can never be eliminated, and well-informed speculation adds strength to the market, but speculative activity has undoubtedly, on various occasions, accentuated price variations. Since the war there have been five strong upward price movements: (1) In 1919–20, when the price reached 2*s.* 10½*d.* in March 1920; (2) in 1922–23, when it reached 1*s.* 7*d.* in January 1923; (3) in 1925, when it reached 4*s.* 6*d.* in July, and after a sharp recession it again rose to 4*s.* 8*d.* in December; (4) in 1934, when it rose to 7½*d.* in August; (5) in 1936–37, when it rose to 1*s.* 1½*d.* in March 1937. In each of these periods there was a considerable increase in the current rate of absorption, and in each of them, except 1925, stocks were ample. Furthermore, in 1920, in December 1925, in 1937, and to some extent in 1923, the fundamental cause of the rise was the general belief that a real shortage of rubber was imminent. The antagonism which the introduction of the Stevenson Scheme aroused in 1922, especially in the United States, was due partly to a misunderstanding of its nature and partly to other reasons, but the agitation led the market to believe that manufacturers were short of rubber. The rise in the first half of 1925 would have been far less pronounced if manufacturers had not allowed their stocks to be reduced in 1924, when rubber was, for a considerable period, under 1*s.* per lb., and when an automatic contraction in exports under the scheme was inevitable. As it was, there was little reserve stock to tide over the interval between the rapid increase in absorption and the recruiting and training of additional labour to increase output in Malaya and Ceylon. The rise in 1937 was partly affected by the general speculative movement in all commodities, but it was probably mainly due to the mistaken belief, then widely held, that producers could not produce and export their permissible quantities during the second half of 1937. It was mainly speculative, it was not followed by the trade, and its inevitable reaction has been reinforced by the trade recession in the United States. On each of these occasions the market under-estimated future supplies and over-estimated future absorption, *and the market is far more influenced by future prospects than by current supplies.* On each occasion, except 1937, many manufacturers were making large forward contracts at the higher prices then ruling. Speculative activity undoubtedly accentuated the rise, and when the tide turned, it accentuated the fall. But if the market forecasts had been right, the rise was inevitable.

The speculative movement which set in in 1934 was somewhat different from those just described. Although stocks then were very large, the price was carried to 7½*d*. per lb. in August 1934, in the belief that the minimum price necessary to fulfil one of the avowed objects of the International Agreement exceeded that figure. This belief was no doubt justified, but the initial difficulties which the scheme had to face delayed the realization of a reasonable price for more than two years, but before that time most of the speculators had sold out at a loss.

Large fluctuations in price are harmful both to the manufacturer and to the producer. A steady price is harmful to the market because it leaves too small a margin of operating profit. As the industry is organized at present, a free market where rubber can always be bought or sold is essential both to manufacturers and to producers, and to maintain an efficient market some fluctuation of price is necessary. If speculative activity be confined to carrying rubber when it is not wanted and selling it (at, of course, a reasonable margin of profit) when it is wanted, it is performing a useful function. The trouble is that so many weak speculators buy and sell at the wrong time.

Productive capacity with a price of about 9*d*. per lb. is well in excess of current absorption, and provided producers carry a sufficient labour force, they will be able to produce, and export quickly, any increase in the permissible quantity. But if estate producers, in order to ensure adequate supplies, are to maintain a labour force in excess of immediate requirements, and cannot use that force for other purposes, *e.g.* replanting, they might reasonably expect that the additional expenditure incurred will be reflected in the price which they obtain for their rubber. The rapidity with which supplies can be increased is more important for the market and for manufacturers than any considerations of a normal stock. A temporary excess in demand is soon likely to work itself out, and need not cause serious fluctuations if manufacturers carry a sufficient stock. Low stocks by themselves will not attract undue speculative activity if it be known that supplies can be rapidly increased. And if, from some unforeseen cause, absorption should suddenly increase and exceed the supplies available at, say, 9*d*. to 10*d*. per lb., then a higher level must be established to bring out the necessary supply. Producers, by drawing on their existing bark reserves could supply, for a time, a considerable quantity of additional rubber. A temporary excess in supplies, due to a sharp decrease in absorption, can only be corrected by a corresponding reduction in the exportable percentage. Apart from the fact that frequent changes of any considerable magnitude raise administrative difficulties in the regulating countries both to the regulating authorities and to producers, there is always the difficulty of foreseeing how long the contraction in absorption will continue and what rate of absorption will be established once the decline has come to an end. In the meantime arrivals in manufacturing countries, at the higher rate of release, will be in excess of current absorption; and the ratio of stocks to absorption will mount rapidly. The uncertainty in the future outlook, which will already have depressed the price, makes decisions by the International Rubber Regulation Committee a matter of considerable difficulty, and there is always the tendency to delay action until the absorption situation has become clearer.

In order to prevent an undesirable rise in price the formation of a buffer stock has been suggested. An adequate discussion of buffer stocks would take far more space than I have at my disposal. The practical difficulties in the establishment and operation of such a stock, assuming that it can be financed, seem to me to be considerable, and there is no guarantee that, if established, it would be effective in limiting a rise in price. Its amount would have to be substantial. Manufacturers and dealers, seeing a large and growing buffer stock, would tend to reduce their stocks to a bare minimum, and producers would also be apprehensive, for if anything happened to the scheme —and the world is full of political uncertainties to-day—the liquidation of this stock would have a disastrous effect. It would have to be operated by the International Rubber Regulation Committee, and would more likely hinder than help them. In any case, it is unnecessary, for temporary undesirable rises due to a sudden increase in absorption can more easily be met if producers carry a labour force capable of effecting a rapid increase in their permissible exports and if manufacturers carry an adequate stock. This, in turn, would enable the International Rubber Regulation Committee to take quick and, if necessary, drastic action to prevent too serious a fall in the price.

Variations in the totals of the declared stocks are not always in close agreement with the corresponding differences between new supplies and absorption. These discrepancies are due mainly to the rough method of estimating the afloats, although stocks may disappear, for a time, in the United States. As a check on the declared figures, monthly figures should be calculated by starting with the total stock at the beginning of the year and adjusting this figure for the monthly differences between exports and absorption. As Singapore and Penang stocks are included in the declared stocks, the exports under the scheme for Malaya must be used in the monthly export figures.

Even if there were no interruption of supplies from any source, there would still be a seasonal movement in stocks in manufacturing countries, as absorption is generally about its highest at the middle of the year, when arrivals in manufacturing countries, owing to wintering, are at their lowest. Wintering varies in intensity, and manufacturing activity frequently reaches its maximum during the second half of the year. But purely seasonal variations can always be allowed for even if they cannot be calculated accurately, and need not exercise more than a temporary effect on the price.

In the rubber industry, as in the case of many other raw commodities, there are two classes of stocks interposed between the production and real consumption. These are the stocks of crude rubber and the rubber content of the stocks of manufactured goods, including the unused tyre mileage on automobiles. Crude rubber stocks are known, but with the exception of the tyre stocks of manufacturers in the United States, given in Table XII, and some indication of the movements in the tyre stocks of dealers in the United States, published by the Department of Commerce, no data on the stocks of manufactured goods are available. During a period of depression the latter are steadily reduced, while the former, unless output is regulated, steadily increase.

VII. Prices

The highest, lowest, fluctuation, and average price of Standard Quality Rubber in London for each year since 1910 are given in Table XVI. In each of those years the fluctuation expressed in terms of the average price has been considerable. Since the beginning of 1920 the price of standard grades of plantation rubber has averaged 11⅞*d.* per lb., and since the estate output consists of from 15 to 20 per cent. of off-grades, the average spot price of the total estate output has been somewhat less.

The average annual price of standard sheet in London, of standard sheet and re-milled native rubber (Singapore Medium Blanket) in Singapore, and of native smoked sheets in the up-country markets in Malaya, for the years 1935–37, are given in Table XVII. The price of the Malayan native smoked sheets includes the export duty

TABLE XVI

Highest, Lowest, Fluctuation and Average Price per lb. of Standard Quality Rubber in London*, 1910–37

	Highest		Lowest		Fluctuation		Average	
	s	*d*	*s.*	*d.*	*s*	*d*	*s*	*d*
1910	12	9	5	7	7	2	8	9
1911	7	3	4	6	2	9	5	5½
1912	5	9	4	1	1	8	4	9
1913	4	6½	2	0	2	6½	3	0¼
1914	3	0	1	11½	1	0½	2	3½
1915	4	1½	1	11¾	2	1¾	2	6
1916	4	3½	2	1¾	2	1¾	2	10¼
1917	3	4½	2	2¾	1	1¾	2	9¾
1918	2	6¼	2	0		6¼	2	2¾
1919	2	10½	1	7	1	3½	2	0¾
1920	2	10¼		9	2	1¼	1	10½
1921	1	2		7		7		9 9/16
1922	1	3		6¾		8¼		9 5/16
1923	1	6⅝	1	1¼		5⅜	1	3 5/16
1924	1	8		9½		10½	1	1⅞
1925	4	8	1	4½	3	3½	2	11 1/16
1926	3	9¾	1	6	2	3¾	1	11¾
1927	1	8½	1	3¾		4¾	1	6 7/16
1928	1	8		7¾	1	0¼		10¾
1929	1	1½		7¾		5¾		10¼
1930		8 7/16		3 9/16		4⅞		5 15/16
1931		4¼		2¼		2		3⅛
1932		3¼		1 11/16		1 9/16		2 5/16
1933		4⅜		2		2⅜		3¼
1934		7⅝		4 3/16		3 7/16		6¼
1935		6 13/16		5 3/16		1⅝		6
1936		11⅛		6½		4⅝		7¾
1937	1	1¾		6¾		7		9½

* 1910–17—Standard Crepe.
1918–37—Standard Quality Ribbed Smoked Sheet.

TABLE XVII

Average Annual Price in Pence per lb. Estate and Native Rubber, 1935–37

	London Ribbed Smoked Sheet	Singapore		Up-Country Malaya Native Smoked Sheet Plus Duty
		Standard Sheet	Singapore Medium Blanket	
1935	6·00	5·73	5·23	5·29
1936	7·75	7·61	7·51	7·36
1937	9·49	9·03	8·42	8·65

payable when they are exported. The re-milled blankets and the native smoked sheets are the principal exportable grades of native rubber. The prices given are not, of course, the prices the natives receive for their output, owing to processing, transport and other charges that have to be incurred before the native rubber can be exported.

Stocks and price are the normal indicators of the relation between production and absorption. Stocks merely indicate past history, but price is affected by future prospects.

VIII. REGULATION OF SUPPLIES

Wide fluctuations in the spread between productive capacity and actual absorption have been inherent in the industry. The rubber trees, as we have seen, take five to six years to reach the productive stage, and another six years, at least, before they approach their maximum productivity. The yields of both old seedling and old budded rubber, under existing cultivation practice, are still a matter for conjecture. Unregulated production, especially of native rubber, is influenced by the price. Motor transport has developed rapidly during the past forty years, but 70 per cent. of the automobiles in use in the world to-day are in the United States. Motor transport, responsible for two-thirds of the annual absorption of rubber, has made the rubber industry, both in its producing and manufacturing sides, susceptible to general trade fluctuations. The continuous improvement in the life of automobile tyres has probably not yet come to an end. A vast amount of scientific and technical research has developed, and is still steadily developing, new uses for the commodity.

It has, therefore, never been possible in the past, and it is not possible to-day, to make accurate estimates of production and absorption for a period of ten to fifteen years. In these circumstances the price of the commodity has been, and is still, the only possible stimulus to new planting. Capital could not otherwise be attracted to the industry. Although prices on one or two brief occasions during the past twenty years may have been rather high, the manufacturing industry has never been held up for lack of supplies. As annual planting has been carried out in waves, annual increases in productive capacity must exhibit a similar wave movement, the maxima in the production increments occurring about ten years later than the generating maxima of the planting increments. Absorption also occurs in waves which are roughly coincident with the fluctuations of general trade activity. In 1920–22 and again in 1929–32 productive capacity increments were approaching a maximum when absorption increments were approaching a minimum.

Voluntary regulation of plantation rubber supplies of over 2,000 estate producers and 1,250,000 native producers of various nationalities and races is impossible. Voluntary schemes have indeed been attempted. In 1917, owing to shortage of freight, large stocks were accumulating in the East, and a voluntary scheme, recommended by the Rubber-Growers' Association, curtailed production by some 30,000 tons in 1918, which helped to relieve the situation. Again, the voluntary scheme of the same Association which was in force from November 1st, 1920, to December 31st, 1921, and which was supported by the corresponding Association in the Netherlands, helped to alleviate the situation, but it was not comprehensive enough to effect a permanent improvement, and was not renewed.

The Stevenson Scheme, which regulated compulsorily the exports from Malaya and Ceylon and, voluntarily, the exports of rubber from over 90 per cent. of British estates in the Netherlands East Indies, came into force after prolonged negotiations on November 1st, 1922. The space at my disposal permits of only a brief summary of its method of working; a complete discussion of the scheme and of the various misrepresentations from which it suffered, some of them deliberate, would require a paper by itself. A standard production was assessed to each producer affected by the scheme, and he obtained rights to export, at a minimum rate of duty in Malaya and Ceylon, during any restriction quarter, a percentage of his standard. He could export more; but if he did, a high rate of duty was levied on the whole of his exports, and this in practice was effectively deterrent. The percentage of the standard production exportable at the minimum rate of duty was determined *automatically* by the average price in London of Standard Quality Ribbed Smoked Sheet, and was initially fixed at 60. The pivotal price was 1*s.* 3*d.* per lb., and so long as the average price during any restriction quarter remained between 1*s.* 3*d.* and 1*s.* 6*d.*, the exportable percentage was increased by 5 during the following quarter. If the average price in any restriction quarter was 1*s.* 6*d.* or over, the percentage was to increase by 10 during the following quarter. No reduction could be made in the percentage unless the price averaged less than 1*s.* 3*d.*, and the reduction in the percentage was limited to 5 for any quarter unless the price averaged less than 1*s.*, when the percentage fell automatically to 60. The percentage could not fall below 60 unless the price averaged less than 1*s.*, but if it did fall below 60, it continued to be reduced by 5 each quarter so long as the price was under 1*s.* 3*d.* The automatic determination of supplies by the price and the practical difficulties of altering the percentage more frequently than once a quarter made the scheme too slow in effecting the necessary adjustments. But the intention of the scheme was to place the increases and decreases of supplies in the hands of the buyers, and in any case, opinion at the time the scheme was introduced was not ripe for arbitrary regulation. After the price upheaval in 1925—which was due mainly to fear of an impending shortage—the scheme was made more flexible, and at the same time the pivotal price was raised to 1*s.* 9*d.*, in order to protect manufacturers with their high-priced forward contracts entered into in 1925, and to encourage new planting. New planting, which was freely permitted under the scheme, had been carried out on a comparatively small scale during the years 1921–23, and the reports of the Netherlands East Indies Native Rubber Investigation Committee, issued about that time, suggested that a great part of the new native extensions in 1924–26 would be necessary to maintain its productive capacity. It is clear now that the raising of the pivotal price was a mistake. Productive capacity exceeded the current estimates by a considerable margin. Absorption fell far below manufacturers' estimates. Before the end of 1926 all fear of an impending shortage had disappeared, and in these circumstances a price of 1*s.* 9*d.* encouraged excessive planting. The scheme was withdrawn on October 31st, 1928.

At the time the scheme was removed the absorption of rubber was increasing fairly rapidly, and when the accumulations in the East, already referred to, had been distributed throughout the manufacturing countries, the price began to rise, and reached 1*s.* 1½*d.* per lb. in February 1929. Exports of Netherlands East Indies native rubber, however, came forward at a greater rate than had been expected, the production of native rubber in Malaya was showing an unexpected increase, and the resting during the restriction period, together with improved methods of cultivation, had increased the productivity of estates. Supplies were exceeding expectations, and the price declined by the end of March to 11*d.* per lb. It fluctuated between 10*d.* and 11*d.* until October 1929, when the collapse of the speculative boom in Wall Street ushered in the great depression, and the price of rubber began to fall more rapidly. By the end of 1929 it had fallen to 8*d.*, and by the end of 1930 it was 4¼*d.* Negotiations between the British and Netherlands producers, which were renewed during 1930, were brought to a standstill in August of that year, when the Governor-General in the Netherlands East Indies declared that they could not regulate the exports of their native rubber. They were renewed from time to time, however, but in March 1932 it was announced that, after a careful review of the situation, the British and Netherlands Governments had been forced to the conclusion that, under existing conditions, it was impossible to frame and operate an international scheme which would guarantee the effective regulation of the production or export of rubber.

The finances of the Netherlands East Indies are largely dependent on the exports of raw commodities, the local prices of which, already depressed, were adversely affected by the devaluation of the pound and the dollar, and in 1933 the Netherlands Government felt compelled to review its previous decision. After prolonged negotiations an International Agreement was signed by representatives of the governments of all the important producing countries in the East in May 1934, and the existing regulation scheme was brought into force on June 1st of that year.

Under this agreement each country, except French Indo China, was granted a quota, which, as far as possible, was based on the average exports from that country during the four years 1929–32, together with allowances for rubber which was not fully mature during that period. Some of the quotas had to be revised later, as the statistics available at the time they were calculated were incomplete. The existing basic quotas are given in Table XVIII. No quota was assigned to French Indo China, although that country was included in the International Agreement, but if its exports exceeded 30,000 tons in any year, but were less than the net imports into France during that year, the French Indo China authorities had to hand over to the International Rubber Regulation Committee 10 per cent. of the excess of the exports over 30,000 tons in the form of Singapore standard sheet or crepe. If the exports were greater than the imports into France, an additional quantity equal to the

TABLE XVIII

Basic Quotas (International Rubber Regulation Scheme)

Area (1)	1934 (2)	1935 (3)	1936 (4)	1937 (5)	1938 (6)
	Tons	Tons	Tons	Tons	Tons
Straits Settlements, F.M.S., U.M.S., and Brunei ...	7/12ths of 501,000	538,000	569,000	589,000	602,000
Netherlands East Indies ..	7/12ths of 352,000	400,000	500,000	520,000	540,000
Ceylon	7/12ths of 77,500	79,000	80,000	81,000	82,500
India	7/12ths of 6,850	12,500	12,500	12,500	13,000
Burma	7/12ths of 5,150	8,000	8,500	9,000	9,250
State of North Borneo ...	7/12ths of 12,000	13,000	11,000	15,500	16,500
Sarawak	7/12ths of 24,000	28,000	30,000	31,500	32,000
Siam *	7/12ths of 15,000	40,000	40,000	40,000	40,000
Total	7/12ths of 996,500	1,118,500	1,251,000	1,298,500	1,355,250

* The calculation of permissible exportable amounts for Siam is subject to the provision of Article 4 (b) of the International Agreement.

N.B.—No basic quota has been allotted to French Indo China and no restriction is placed on exports from this country, except that part of any exports in excess of 30,000 tons a year is to be delivered to the I.R.R.C. as stipulated in Article 6 of the International Agreement.

international restriction percentage of the excess of the exports over the imports into France was also to be handed over. This was afterwards commuted to a money payment based on the market prices in Singapore during the year.

The percentage of the quota which can be exported is determined by the International Rubber Regulation Committee, whose headquarters are in London. Their decision applies to all quota countries, except Siam, whose percentages for the period of the first agreement have been fixed at 75 for 1935, 85 for 1936, 90 for 1937 and 100 for 1938. Siam did not enter the agreement until the beginning of 1935.

With the minor exceptions already referred to (see Section II, Paragraph *a*(1)), new planting in all the signatory countries was forbidden during the currency of the first agreement, but each producer in any of those countries could uproot and replant up to 20 per cent. of his area under rubber at June 1st, 1934.

The distribution of the permissible exports for any country amongst its individual producers was left entirely to the local authorities. For all countries, except native rubber in the Netherlands East Indies and Sarawak, the procedure of the Stevenson Scheme was adopted. A standard production is assessed to each producer, and the quantity of export rights which he receives during any period is calculated as a percentage of his standard production. As the total of the individual standard productions for any country generally exceeds the quota allotted to that country, and as the method of assessing the standard production, being left to the local authorities, varies from country to country, the percentage of his standard which a producer is allowed to export during any quarter also varies from country to country, and is generally less than the percentage determined for that quarter by the International Rubber Regulation Committee. Export rights issued are valid only for the country for which they are issued, but within that country can be freely transferred amongst producers.

Up to the end of 1936 the exports of native rubber from the Netherlands East Indies were regulated by means of a variable export duty on the general principle that their output depends on the price. Although the export duty had to be high, the native exported more rubber and received on the average more per pound for his product than during the depression years. No other method of regulating the exports of native rubber was possible when the scheme came into force, as there are over three-quarters of a million independent producers, and their holdings had neither been registered nor surveyed. During the first two and a half years of the regulation scheme the Netherlands East Indies authorities completed the heavy labour of registering and roughly surveying their native holdings, and as from January 1st, 1937, the whole of the native exports from the Netherlands East Indies are regulated by export rights in the same manner as those of estates. Sarawak, whose planted areas are mainly in the hands of natives, was faced with the same difficulties as the Netherlands East Indies, and they have regulated their exports by periods of cessation of tapping. In the meantime their holdings have also been registered and surveyed, and their exports from the beginning of February 1938 have been regulated in the same manner as those of other countries.

The existing scheme is about as flexible as it is possible to make it. Alterations in the international percentage can theoretically be made at any time and to any extent. In practice, however, owing to the enormous number of native producers, it is inconvenient to alter the percentage more frequently than once a quarter, and unless the estates have ample labour, too rapid an increase in the international percentage may not be immediately followed by a corresponding increase in the quantity exported. But no scheme, however flexible on paper, can in practice immediately adjust supplies to sudden and unexpected variations in absorption of the magnitude experienced in the last quarter of 1937. Most of the export rights issued to estate producers are utilized to export their own produce, and the comparatively small number of estates that do not wish to export their full permissible amount can sell their surplus rights to others who wish to export more. Most of the natives sell their rights and rubber separately, and in all countries, except the Netherlands East Indies, estate rubber can be exported on native rights. Now that the standard production of each producer, estate and native, has been assessed, and that it is possible, in rubber, to take from the trees approximately the quantity which is permitted to be exported, there seems to be no reason why the scheme should not work smoothly. The International Rubber Regulation Committee are assisted in their deliberations by a manufacturers' advisory panel representing most of the important manufacturing countries, and have at their disposal the most complete and up-to-date information that it is possible to have.

The scheme is the dominating factor in the distribution of rubber at present, and its operation cannot be neglected either by the manufacturer or by the producer.

When the scheme came into force, the declared stocks outside the regulated areas, including the stocks held by the customs authorities in those areas, amounted to 700,000 tons. By June 30th, 1937, they had been reduced to 385,000 tons, but by December 31st, 1937, they had increased to 530,000 tons. The net reduction at the end of 1937 was 170,000 tons. The scheme has been successful in reducing stocks. It has not been successful in maintaining a price which will be reasonably remunerative to an efficient producer. Up to the end of 1937 the average exportable percentage has been 73·8 and the average price of Standard Quality R.S.S. London has been 7·6*d*. per lb., and with the output of "off-grades" the average spot price of estate rubber has been under 7½*d*.

IX. RECLAIMED RUBBER

Reclaimed rubber is obtained mainly from worn-out rubber goods; its chemical composition and properties are different from those of crude, for the reclaim still contains combined sulphur and the other compounding ingredients. The actual hydrocarbon content, therefore, is probably between 50 and 60 per cent. of the total; in other words, to get the same hydrocarbon content about 2 lbs. of reclaim must replace 1 lb. of crude. Articles with considerable proportions of reclaim have poor extensibility and poor resistance to abrasion. In rubber tyres, for example, the average proportion of reclaim to crude is low; most tyre manufacturers are emphatic in stating that there is no reclaim either in the tread or in the carcase of their first line tyres. In other goods which are not

TABLE XIX

Reclaimed Rubber in the United States

Year	Absorption of Reclaim (1)	Percentage to Crude (2)	Price of Standard Crude, New York (3)	Price of Reclaim * (4)
	Tons		U.S. cents per lb.	U.S. cents per lb.
1921	41,400	24·3	16·3	12·7
1922	54,500	19·1	17·0	10·2
1923	69,500	22·8	29·6	9·6
1924	76,100	22·7	26·0	8·9
1925	137,000	35·3	71·9	10·4
1926	164,500	44·9	48·5	10·5
1927	189,500	50·8	37·6	8·8
1928	223,000	51·0	22·3	8·2
1929	217,000	46·5	20·5	7·9
1930	153,500	40·8	11·9	6·6
1931	123,000	35·1	6·1	5·1
1932	77,500	23·3	3·4	4·2
1933	85,000	21·2	5·9	4·7
1934	100,600	22·2	12·9	5·3
1935	117,500	23·9	12·3	5·4
1936	141,500	24·6	16·4	5·4
1937	159,200	29·3	19·3	6·3

* Black selected Automobile Tyre from 1928.

subject to abrasion, the proportion of reclaim to crude can be high. The use of reclaim has been developed more widely in the United States than in other countries, and during the last fifteen years there have been great improvements in the method of reclaiming and in the quality of the product. The proportion of reclaim to crude used in the United States, the price of reclaim and the price of crude are given in Table XIX. This proportion has varied with the price of crude rubber. But reclaim is a definite compounding ingredient, and not only a substitute for crude when crude is dear. It facilitates the breaking down of crude, and it is a convenient manner of introducing various ingredients into a rubber mix. Because of these specific properties, some reclaim will always be used, no matter what the price of crude rubber may be. The price of reclaim was higher than the price of crude during 1932, yet the percentage of reclaim to crude was over 20, and it is not likely to fall below this level in the United States, no matter how low the price of crude may fall. This factor should be kept in mind when considering the effect, on the absorption of reclaim, of an increase in the price of crude.

Data on the absorption of reclaim in other countries are rather scanty, but the proportion of reclaim to crude, although it appears to be increasing, is still below that of the United States. In the United Kingdom it was only 8·3 per cent. in 1934, and 8·9 per cent. in 1935.

Reclaim has now a definite value of its own, and the time when it was looked upon merely as a shoddy substitute for rubber has long since passed away.

Finally it gives me much pleasure to express my thanks to my firm, Messrs. Harrisons & Crosfield, Ltd., for allowing me to use the data which have been collected over a long period of years, and also to the staff of the Statistical Department for help in preparing the tables in this paper. The opinions expressed in this paper are entirely my own, and for them my firm are in no way responsible.

References.

[1] *Rubber Growers' Association Bulletin*, July 1936 (Supplement), December 1936.

[2] *Automobile Facts and Figures*. The Automobile Manufacturers' Association, New York.

DISCUSSION ON DR. RAE'S PAPER.

SIR HARRY LINDSAY: I have very great pleasure in moving a very hearty vote of thanks to Dr. George Rae for his paper, and I do so in all confidence, because I think he has done a very great work in two directions. I congratulate him, first of all, on sticking so closely to his subject and, secondly, on combining that with his success in bringing out from statistics all the conclusions that he wished to arrive at. To treat statistics as he has treated them is a very difficult piece of work, and I think that we ought all to congratulate him very heartily on his success.

I was rather struck by the gap which exists between the year 1839, when Goodyear first patented his vulcanizing process, and 1910, when Dr. Rae's statistics began. (Actually, I think, without being too pedantic, one might have gone back to 1820, when Hancock patented his processes for grinding and treating rubber.) I believe Goodyear was not himself responsible for that process, but relied upon an intelligent foreman, Hayward, who had had a dream that sulphur was the right thing to use. He capitalized that dream by selling the patent to Goodyear for 200 dollars. I suppose if this sum had multiplied by compound interest from that day to this it would represent something like the ultimate value of that patent to the industry. Then Thomson invented the pneumatic tyre in 1845. In 1876 Wickham took seedlings to Kew—at the expense of the Government of India, although the full credit for them went first to Ceylon and to Malaya. So it was a long time before the industry attained premier rank and before Wickham's seedlings could bear their legitimate fruit in large-scale plantations, which date only from 1910.

There is another thing which strikes one in reading the statistics: that rubber is an extraordinarily neat, controllable industry compared to others of similar size. I refer to industries like tea, coffee, sisal and so on, where you have mass production in one part of the world and mass consumption in another. I took the trouble to look out the statistics of the group—tea, coffee, sisal—and also of jute and tin. Why rubber stands out so prominently above the others is that they had reached their heyday long ago, whereas rubber entered into its heyday only in 1910.

But there is this further point, that there is a very close connection between the price and the production of rubber. On looking at Table III it will be seen that the last two lines show respectively the grand total of production, year by year, from 1929 to 1936, and the average price in pence per pound for each of those years. If the lines are followed it will be seen that every fall in price from 1929–30, 1930–31, 1931–32, is accompanied by a fall in the production; in 1933 there is a rise in price and a rise in production; in 1934 there is a still greater rise in both price and production; in 1935 the price falls very slightly and production also falls, and in 1936 there is a rise in both. It may be pure coincidence, but it seems to me that those two lines of figures do show that the rubber industry is what may be called a controllable industry.

With regard to tea, coffee, sisal, jute and tin, the reason for the slowing down of demand (which happened since the turn of the century) is that they had then reached the optimum conditions of demand and supply, and up to that point the producer had been able successfully to stimulate his own production. From that point demands did not increase in the same ratio, and had to be stimulated, to absorb increasing production. Sooner or later every great industry is bound to reach that stage in its development. That stage has certainly been reached in regard to the other industries mentioned; has it been reached in regard to rubber? That is the point we ask ourselves and to which Dr. Rae is helping us to find a solution.

The fact that this is a consumers' market is illustrated by every hoarding which invites the passer-by to "Drink more tea" or coffee, or to "Drink more milk." I do not think that the rubber industry has yet reached the stage of inciting us to "Ride more bicycles," but that is because the potential future demands are still great, and probably increasing.

The most interesting part of the paper, if I may say so, was that in regard to the subject of control, with its kindred questions of stocks and prices. I feel very much with Dr. Rae that the success of the control scheme is much facilitated by the presence on the International Rubber Regulation Committee of representatives of the manufacturers. It stands to reason that if you have a Committee on which the producers and the consumers get on either side of a table, and if they are able to reach some sort of satisfactory conclusion—good luck to them, because the general public must toe the line. Where I do not agree with Dr. Rae is with regard to what he says on page 354 about prices:—

> "Large fluctuations in price are harmful both to the manufacturer and to the producer. A steady price is harmful to the market because it leaves too small a margin of operating profit."

Dr. Rae goes on to say that he cannot control stocks; they must be allowed to fluctuate, and now he says you cannot really expect a stable price. But if neither your price is going to be stable, nor the stocks, what is the use of the producer and the manufacturer getting round a table and trying to arrive at an agreed conclusion? I should have thought that at any rate it was possible to say such and such a price could be both high enough to give a profit to the producer and yet also low enough to satisfy the manufacturer. Between the two there must be some hope of approximate stability. At any rate, we are surely approaching the time when fluctuations will by means of an agreed policy narrow down to an absolute minimum.

I feel with regard to stocks that they are going to influence markets less and less in the future. A large stock, after all, is a safety-valve, a reserve on which the manufacturer can draw in the future, and does not necessarily indicate over-production.

With regard to future demands, there is a reference on page 344 to goods other than automobile tyres:—

> "The increase in the absorption in goods other than automobile tyres from about 40,000 tons to nearly 100,000 tons in

> 1920 and to almost 350,000 tons in 1937, has been largely due to the steady development of new uses for the commodity."

Among those new uses, I suggest to Dr. Rae, are the complex uses which rely upon the use of latex as such. There is a reference in the paper to latex on page 327 :—

> "Apart from the shipment of a small quantity of rubber in latex form, over 80 per cent. of the estate output is in the form of standard grades, Ribbed Smoked Sheet and First Latex Crepe; the remainder consists of off-grades,"

but I understand that the exports of latex actually increased from only 2000 tons in 1927 to 28,500 tons in 1936, so that here again is proof of the absorption of rubber in directions, and in a form, independent of the automobile industry.

The most important factor of all is the United States and its bearing on the situation. Personally, I think that the Regulation Scheme has done wonders under extraordinarily difficult situations. You have the bulk of the production going to America for consumption there. Table VI shows that in the early years from 1910 to 1920 about half of the total exports of rubber were consigned to the United States, three-quarters from 1920 to 1924, two-thirds from 1924 to 1929, and now back to about half; but that is a market where the current standard of demand is the most unsettling feature of the industry. You do not know where you are! The American business man seems to alternate between a diet of sugar-plums and castor oil; at present it is the turn for the castor-oil treatment and the result is that the demand for industrial raw materials falls off. He will sooner or later swing back to his sugar-plums, but the industry as a whole will be no better off for that.

Finally, with regard to future prospects, I suppose that the automobile in the backward countries might be encouraged by the development of roads, but that would be a very slow process. When rubber *on* the roads is matched by rubber *in* the roads, we may get an important stimulus to the industry. The question of rubber for roadways is one which is being seriously examined by the Rubber Research Committee for Malaya and Ceylon, which functions at the Imperial Institute, and some valuable results have already been achieved.

Sir, I beg to move a very hearty vote of thanks to Dr. Rae for his most interesting paper.

SIR ALFRED FLUX said that a couple of points had occurred to him while Dr. Rae was speaking, of which he had been thinking during the debate and to which he felt justified in making reference. One related to some remarks Dr. Rae made about floating stocks. He gathered—but possibly heard wrongly—that Dr. Rae said that the information as to the amount of floating stocks was not very well based.

[Dr. Rae, intervening, made it clear that he had not desired to convey that impression.]

Sir Alfred wished to revert to a point to which Sir Harry Lindsay had referred (page 367). They had, in reference to some of the staple commodities of the world, such as wheat and cotton, been accustomed to believe that the existence of an organized market was a steadying influence in price, and it therefore came somewhat as a shock to read words that seemed to imply that the condition of the maintenance of the market should be unsteady prices. "A steady price is harmful to the market" (p. 354). It was an extraordinary position. Surely it might be possible to organize an effective market in a world commodity such as this without doing it to the necessary harm of the two end interests, or failing to provide an adequate reward for the services of those engaged in the conduct of the market. This was what struck him, and he rather thought that Sir Harry Lindsay felt the same. He suggested that it was a point that might gain from further consideration.

There was so much in the paper that one could only pick up outstanding points, but, when printed in the *Journal* of the Society, it would be readily accessible to all those possessed of the necessary knowledge and experience to give it careful consideration, and its full importance would be appreciated.

It had already been agreed that thanks were due to Dr. Rae, and he felt personally greatly indebted to him.

If Dr. Rae wished to take the opportunity of replying to what had been said in the debate, there was some time still available, but he would remind him that an opportunity would be found for expressing his views in regard to the course of the debate in the printed report of the proceedings that would appear in the *Journal*.

Mr. F. D. Ascoli said that when he came to the meeting he thought that the statistics published by the International Rubber Regulation Committee constituted the whole body of statistics of the industry; he now found he was mistaken, and he would like to congratulate Dr. Rae on the very instructive and illuminating body with which he had clothed the rather dry bones of the usual statistical publication. He (the speaker) had himself read papers on this subject, and had always had the prudence to read them before Societies connected with the rubber industry, in order to avoid criticism of his somewhat superficial knowledge of statistics. Dr. Rae had taken the other course, possibly in the hope of avoiding criticism of his knowledge of the rubber industry, but Mr. Ascoli could assure all present that Dr. Rae's knowledge called for no criticism, and there were only two minor points in the paper that he would like to mention in that respect.

Dr. Rae referred to the fact that the tree was ordinarily tapped at the end of five years, but the date of tapping depended upon the price of the commodity. Mr. Ascoli, however, did not think that any prudent planter would dare to tap a tree at that age, as recent experimental work had shown that to tap a tree at any early age was a definite shock and retarded its growth and accordingly its girth. One of the main factors in the yield of a tree was its girth, which gave the necessary length of cut for tapping.

The other point of criticism was that Dr. Rae suggested that a 50,000-mile life for a tyre was something exceptional. Speaking from the manufacturing side of the industry, this was by no means exceptional, and with heavy transport a life of 50,000 miles was almost moderate. If all motorists would confine their speed to that of the omnibus, they would realize that.

There was one point as regards the statistics of the industry which Dr. Rae had perhaps not brought out, and that was the extreme complexity of the basis of statistics for the producing side. He had referred to the millions of acres under cultivation and to the small output per tree; but he had not referred to the almost countless individual operations involved in obtaining the total production. It was important to recognize the difficulties of ensuring accurate statistics where such intricacies existed at the bottom.

Assuming that a tree produced on an average 4 lb. of rubber a year, that would require 160 operations in the year on each tree. To get sufficient rubber for a single average-sized tyre it was necessary to tap four trees for the whole year, involving 600 to 700 operations. To get 1 million tons of rubber, 100,000 million operations were necessary, involving the cutting of 40 million linear miles and many thousands of acres of bark, all of which had to be renewed by fresh growth in the course of 8 years, if world supplies were to be maintained.

These figures might sound astronomical, but, though not entirely accurate, indicated the pitfalls met with when building up statistics from small beginnings. The position was not becoming easier. In the old days before the advent of budded rubber the difference in yield in different areas was comparatively slight. Growers were satisfied with 400 lb. an acre; with budded rubber the position was entirely different. Dr. Rae had given certain figures, but he had not indicated the enormous difference in yields obtained from budded rubber of different families of trees. From an ordinary proved Clone at least 1000 lb. an acre would be expected, but new families were being developed from which one could expect 2500 or 3000 lb. an acre. This would indicate how difficult it was going to be to forecast statistical production from what was known of the tree itself.

Mr. Ascoli had always considered statistics to be of major importance in any industry, but their value was not always realized. A short time ago there was a meeting in London of rubber manufacturers to discuss the possibility of starting a statistical survey, and to prepare statistics similar to the excellent statistics published in America, to which reference had been made. There was quite a measure of agreement until one manufacturer said: "American statistics! Look what a mess they have made in the industry over there!" He himself would not suggest that statistics could have that effect in any industry. Their object was to record the past, to help to value the present and to forecast the future.

Mr. Ascoli said he was often called upon to forecast the future production, consumption, and even price. He invariably used statistics for the purpose; he supposed he was wrong as often as he was right, but when, on finding himself wrong, he consulted his statistics, he felt he had failed to understand what they meant, and that if he had studied them better his guess would have been nearer —in fact, it would not have been a guess.

A few days ago he had a horrible example of the value of statistics which he would like to bring to the notice of those controlling the industry. He was reading *The India Rubber World*, and came across a chart containing two curves. The trend of those curves was exactly the same. He looked at the title, and started reading the article, and found that these curves represented the price of rubber under the Stevenson Restriction Scheme (1922) and the present scheme. The Stevenson Scheme was based on entirely different principles, and in his opinion it was bad, whereas the present one was good, but the effect of both schemes on price was identical. Starting with a temporary rise, this was followed by a fall, then came stagnation, then a sudden rise, a sudden fall, a little stagnation, and then a further rise. If any present were interested in rubber and believed in statistics, he could assure them that there would be a rise in the price of rubber in August or September.

They were all very grateful indeed to Dr. Rae for what he had done. Many in the industry were constantly referring to statistics, and to get them in compact form with reasonable deductions from the figures was a great help to all those dealing with the commodity, whether on the producing or the manufacturing side.

SIR JOHN CAMPBELL said he had known Dr. Rae, on paper, for a long time, in connection with that much-discussed institution, the International Rubber Regulation Committee. One of the best things done by that Committee was perhaps to discover, as quickly as possible, the most knowledgeable people as regards rubber. Dr. Rae was one of their discoveries. They had become experts in discovering experts; and, like all Government Departments, having discovered their experts, they worked them very hard; and, equally naturally, paid them nothing for it.

He had been very interested in the lecture. Dr. Rae had given an extraordinarily good summary, from a wider point of view than that adopted by the Committee. Their statistics started from 1928 at present; from that date they were as complete and comprehensive as it was possible to make them. An infinity of time and trouble was devoted to their preparation and improvement. The idea behind their Bulletin was of course not only to give the industry a comprehensive collection of up-to-date world statistics, but also to enable the Governments concerned to follow intelligently what was happening; and to permit people, such as members of the Royal Statistical Society and others, to criticize—they hoped sympathetically—the work of the Committee.

American opinion and practice had been quoted by some of the previous speakers, but there was one American remark he always remembered. Mr. Hosea Bigelow had said, "Never prophesy—unless you know," and experience showed that this was a most useful thing to keep in mind. The mathematician could extrapolate curves, and bring extraordinary refinements to the calculus of finite differences which one employed for that purpose; one felt pleased with the results; but in practice the beastly curves seldom bent the way one wished or predicted.

At the present moment there was a lot of talk about price, for instance; but the price of rubber now depended mainly on what he might term the internal political action taken in the U.S.A. That was a more determining influence upon the price than anything else.

Sir John was also concerned with tin; and it was interesting to find, as an illustration of the point taken above, that until quite recently all the relevant indices were practically the same as in March 1937. Visible stocks were very much the same; there was no material change in any of the important indices; but at one end of the period the price was £313 per ton and at the other end £180 a ton, with no satisfactory statistical explanation of that colossal difference. The explanation was of course market psychology. People thought in March 1937 that there was going to be a shortage of tin due to re-armament and so on; and the consumer rushed to buy tin. After a little, he sat down and considered the situation more calmly; he decided that there was lots of tin; and the bottom at once fell out of the market. No statistics would enable a position of that kind to be predicted, or rapidly coped with.

One of the main difficulties of the Tin and Rubber Committees was to try to meet, adequately and in advance, that sort of situation; and, as Mr. Bigelow had epigrammatically pointed out, it was extraordinarily difficult. Often the Committees were right; sometimes they were wrong. So many elements came into the forecast, and it was most difficult to estimate the effect of a change in one factor on the others. The Committees had able members; there was a most judicious blend of commercial people who had spent their lives in the industry, of officials in close contact with their Governments, and of consumers who saw the industry from another angle, and were mainly interested in getting regular supplies of commodities, at all times, at a reasonable price. The result was two well-balanced Committees. Ever since they had started, they had tried, to the best of their ability, to give a fair deal as between the consumer and the producer; but he was afraid that nothing would ever enable them to forecast the future with close accuracy.

Mr. G. R. White said that an interesting comparison could be made between the figures given in Table VI, Col. 2, for the net imports of rubber into the United Kingdom and those in Table VII, Col. 5, for the absorption of rubber in this country. Since 1924 the former fluctuated between 11,600 tons (an excess of re-exports over imports) and 158,500 tons, while the latter had shown a steady upward trend from 23,000 tons to 99,000 tons. The reason for this disparity was to be found on page 351, where Dr. Rae pointed out that the stocks in the public warehouses in London and Liverpool represented the world's ultimate reserve of crude rubber. It was to these warehouses that rubber gravitated when it could not find a purchaser elsewhere, and it was from these warehouses that the trade obtained additional rubber when, at any time, output was below absorption. This disparity had quite an important influence on the balance of trade.

Taking the average value of imports of crude rubber each year since 1924, Mr. White had calculated the value of the actual yearly requirements of rubber in the country, using the absorption figures obtained from Table VII. He then compared the figures obtained with the value of net imports or, rather, the balance of imports over re-exports.

Over the thirteen years 1924–36, the total value of this country's requirements of crude rubber, calculated in this manner, amounted to £69¼ million, while the total value of the net imports was £67½ million—a difference of only 2½ per cent.

Taking the figures for individual years, however, it was found that in 1926 the United Kingdom paid over £16 million for its imports less re-exports, while its requirements did not amount to £9 million. The excess of net imports over requirements in that year actually represented nearly half the debit balance of payments. Two years later the value of re-exports of rubber actually exceeded imports by nearly £1¼ million, while the requirements of crude rubber amounted to over £5 million.

Taking one further example, in 1934 net imports exceeded requirements by over £3½ million, while two years later there was a difference of £7½ million in the reverse direction.

One could not but reflect that if London provided facilities for other commodities on a similar scale to that which it did for rubber, a yet further qualification would have to be attached to the interpretation of the balance of payments.

Dr. George Rae, in reply, said: I have to thank you for the patience with which you have listened to my paper and for the kind and appreciative remarks on it made by the various speakers. In writing a paper of this nature it is always difficult to know what to put in and what to leave out. I propose to consider the various matters raised in the discussion when the paper is printed in the *Journal*, but there is one point I would like to refer to now—I will discuss it more fully later—and that is, that those of us who are in close touch with the rubber market do not find anything incongruous in the statements I made about the fluctuations in the price.

Dr. Rae later wrote as follows:—

Sir Harry Lindsay suggested that the rubber-producing industry is more controllable than many other similar industries because it is a much younger industry. That may be true to some extent, but I think the principal reason is that rubber is produced mainly in countries with an efficient and highly organized civil service. The heavy task of regulating the exports of individual producers in the various countries under the International Rubber Regulation Scheme is carried out by the collaboration between the civil service and the planting community. That the scheme should have worked so smoothly in the regulated areas is a high tribute to those directly responsible for its administration.

Rubber differs from most of the other commodities mentioned by

Sir Harry, in that, with one or two rather minor exceptions (*e.g.* sole crepe), the commodity has to be processed before it can be used, accordingly a large amount of propaganda and research has been, and is being, carried out to bring the unique properties of the commodity to the notice of potential users. Few people realize the enormous amount of research carried out by the Government Research Institutes and producers' associations in the producing countries and by individual manufacturers and manufacturers' associations in the manufacturing countries. The utilization of rubber in latex form, referred to by Sir Harry, has been an important development of the research activities of manufacturers.

With regard to the fluctuations in the price referred to by Sir Harry Lindsay and by Sir Alfred Flux, I am afraid I have not made myself very clear in the paper. For an industry of the magnitude of the rubber-producing industry an organized market is essential. There are over 2,000 independent estate producers and over 1,250,000 native producers. The total annual value of their exports at the market rates existing when the rubber was exported has varied from £50 million to £100 million during the last few years. It is true that an organized market has a steadying influence on the price, but it is equally true that an organized market in a commodity like rubber cannot operate efficiently unless there is a sufficient fluctuation in the price. Native output is over 40 per cent. of the total, so that every day there is a large quantity of first-hand rubber offered on the market. In periods when the daily offerings of first-hand rubber exceed the daily off-take by manufacturers, the excess must be carried by the market. The financial resources at the disposal of the dealers are limited, and unless the dealers can hedge purchases of spot rubber by forward sales to speculators, there will soon come a point at which they will be unable to carry more rubber even at a greatly reduced price. But the speculators cannot be expected to carry the rubber unless there is some possibility of being able to dispose of that rubber at a reasonable profit later on. The possible fluctuations in the price, therefore, must be sufficient to promise this profit. Speculation of this nature performs a useful and legitimate function by bringing capital into the distributing side of the industry. All speculation, however, is not of this nature, and occasionally there has been reckless speculation which has been harmful to the industry, and frequently unfortunate to the speculators themselves.

I agree with Mr. Ascoli that it is detrimental to the development of the rubber tree, and therefore to its yield, to tap it when it is five years of age, and I understand that it is now the general practice amongst estate producers to postpone tapping of young trees as long as possible. Mr. Ascoli has also sent me, privately, a number of minor corrections which have been incorporated in the paper.

Sir John Campbell has referred to the difficulty of forecasting future demand from past statistics; those of us who have to make such forecasts for rubber are well aware of these difficulties. Every figure is the resultant of a large number of natural, economic and psychological forces, as Mr. Ascoli has indicated with regard to production figures. Few of these forces are capable of exact measurement, they vary continuously, both in direction and intensity; yet a knowledge of these forces, particularly those directly connected with rubber, is essential for the correct interpretation of the past and current statistics of the industry, and for assigning the limits to forecasts for the future.

Mr. White has raised an interesting point which is rather outside the scope of the present paper, but there is one difficulty which I have in his figures. The value of the rubber imported by dealers and manufacturers probably represents the correct amount which they have to pay for the rubber they import, as this amount is already known. On the other hand, the rubber imported by producers domiciled in the United Kingdom to be sold in the London market (the total varies considerably from year to year depending on market conditions), is entered at the spot price of the commodity at the time it was imported. The producers, however, transmit to the East the bare costs incurred by the estate in placing its rubber on board ship at the Eastern port; freight and insurance are generally paid in London.

With regard to the question of quantities afloat raised by Sir Alfred Flux, the method of estimating those quantities generally gives a reasonable approximation, but actual data are not available, and for particular months, owing to delays in shipping and similar reasons, the actual quantities may differ significantly from the calculated figures.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society :—

Noel Frederick Hall.
Eldred Frederick Hitchcock, C.B.E.
Thet Maung.
Ernest Arthur George Shrimpton.
William A. Wilson, M.A., B.S.

WHOLESALE PRICES IN 1937

BY THE EDITOR OF "THE STATIST"

(*The Statist's* Index Numbers in continuation of
Mr. A. Sauerbeck's figures)

THE Sauerbeck-*Statist* index numbers of wholesale prices are set out in the following table. The annual averages are shown for every year since 1846 (that is, from the commencement of the calculations), and Jevons's figures for the years 1810 and 1818, adjusted to Sauerbeck's standard, are also included. These all-commodities index numbers embrace forty-five commodities, and are calculated, with few exceptions, from the average of fifty-two weekly quotations for each commodity, the averages for the standard period 1867–77 being taken as 100. Up to the end of 1912 the compilation of the statistics was made by Mr. Augustus Sauerbeck, and subsequently by *The Statist.*

THE STATIST'S *Annual Index Numbers* (*in continuation of Sauerbeck's figures*)

(1867–77 = 100)

Year	Average No.	Year	Average No.	Year	Average No.	Year	Average No.	Year	Average No.
1937	102	1918	192	1899	68	1880	88	1861	98
'36	89†	'17	175	'98	64	'79	83	'60	99
'35	84	'16	136	'97	62	'78	87	1859	94
'34	82	'15	108	'96	61	'77	94	'58	91
'33	79	'14	85	'95	62	'76	95	'57	105
'32	80	'13	85	'94	63	'75	96	'56	101
'31	83	'12	85	'93	68	'74	102	'55	101
'30	97	'11	80	'92	68	'73	111	'54	102
'29	115	'10	78	'91	72	'72	109	'53	95
'28	120	1909	74	'90	72	'71	100	'52	78
'27	122	'08	73	1889	72	'70	96	'51	75
'26	126	'07	80	'88	70	1869	98	'50	77
'25	136	'06	77	'87	68	'68	99	1849	74
'24	139	'05	72	'86	69	'67	100	'48	78
'23	129	'04	70	'85	72	'66	102	'47	95
'22	131	'03	69	'84	76	'65	101	'46	89
'21	155	'02	69	'83	82	'64	105	'18	159*
'20	251	'01	70	'82	84	'63	103	'10	171*
1919	206	'00	75	'81	85	'62	101		

* Jevons's numbers adjusted. † Revised.

For the year 1937 the annual index number is 102, compared with 89 for 1936 and 84 for 1935. It is the highest for any year since 1929, when the index number was 115. Since the post-war nadir of 79 in 1933, prices therefore rose by 29·1 per cent. During the summer of 1937, however, a peak in the upward movement was reached, and, as the table on page 380 shows, the monthly all-commodities index number, though it reached 106·2 in May, declined steadily with minor fluctuations thereafter, and was down to 96·7 in November. During the present year the decline has continued and the number in March last was 94·2.

THE STATIST'S *Annual Index Numbers—ten-year averages*
(1867–77)

1838–1847 = 93
'48– '57 = 89
'58– '67 = 99
'68– '77 = 100
'78– '87 = 79
'88– '97 = 67
'90– '99 = 66
'91–1900 = 66
'92– '01 = 66
'93– '02 = 66
'94– '03 = 66
'95– '04 = 67
'96– '05 = 68
'97– '06 = 70
'98– '07 = 71

1899–1908 = 72
1900– '09 = 73
'01– '10 = 73
'02– '11 = 74
'03– '12 = 76
'04– '13 = 77
'05– '14 = 79
'06– '15 = 82
'07– '16 = 88
'08– '17 = 98
'09– '18 = 110
'10– '19 = 123
'11– '20 = 146
'12– '21 = 148
'13– '22 = 153

1914–1923 = 157
'15– '24 = 162
'16– '25 = 165
'17– '26 = 164
'18– '27 = 159
'19– '28 = 152
'20– '29 = 142
'21– '30 = 127
'22– '31 = 120
'23– '32 = 115
'24– '33 = 110
'25– '34 = 104
'26– '35 = 99
'27– '36 = 95
'28– '37 = 93

The financial and economic developments which put an end to the promising position which existed in early 1937 are now matters of history. Movements in share prices suggest that the peak of the recovery was already reached at the end of 1936, and early in 1937 it became apparent that the scramble for commodities had forced prices too high, and that while the genuine consumer was tending to restrict purchases, a big speculative position was becoming increasingly exposed. The liquidation began in the second quarter of the year, and successive shocks to business confidence have since prevented any really effective counter-movement from setting in. The sharp reduction in public spending in the United States coincided with labour unrest and disputes between Business and the Administration over taxation and the treatment of the public utilities.

Since the summer a continuous decline in American imports has inevitably affected the trade balances of primary producing countries throughout the world, and their purchasing power is declining as their exports, in value as well as in volume, dwindle. When the hoped-for autumn upswing failed to take place in America, it became increasingly clear that this country could no longer remain unaffected, unemployment began to increase slowly, manufacturers—particularly in the textile trades—reported an increasing decline in new orders, and British imports of raw material fell off.

Stocks of commodities have therefore tended to rise steadily throughout the year, the only counteracting forces being the re-armament and war material demands and the reduction of output quotas under most of the restriction schemes. It is evident that productive capacity is far more elastic than was supposed at the end of 1936, when prices were rising fast, and despite the increase in 1937 in the quantum of international trade to approximately the 1929 level, supply increasingly exceeded demand.

The effect upon commodity prices as reflected by *The Statist* sectional indices was not, however, uniform. The all-commodities index is made up to two groups—food and materials—and each group comprises three sections. The annual group and sectional indices, together with the all-commodities index, are set out in the table on page 381; on page 382 is a table giving the monthly indices since the beginning of 1935, and on the following page quarterly movements are given.

An increase on balance is shown for all of the sectional indices last year, and also for a large number of the indices for the component items. The largest increase was recorded for minerals, and the smallest for textiles, while the increase for all the food sections (including sugar, coffee and tea, which declined between 1935 and 1936) and for sundry material was marked. A better picture of the movement of sectional prices last year, however, is given in the table showing quarterly averages. After rising sharply from the end of 1936, foodstuff prices began to decline slowly after the second quarter, the falls in animal foods and in sugar, tea and coffee being accentuated in the last quarter, but vegetable foods rising, largely on account of the continued high price of wheat following bad harvests and unusually heavy European, in addition to British, imports. Among other cereals, barley, oats and maize have also commanded substantially higher prices. Rice has risen a little above the 1936 level, but potatoes have fallen considerably below it. The increases for animal foods have not been so great as those for cereals, while the rise in the price of sugar has been slight and not well maintained in the later months. Though the average for the year for coffee is well above that for 1936, it is now definitely on the down-grade; stability is shown only by the index for tea.

In the mineral section of the materials group two divergent trends are noticeable: prices of iron and coal being upward and prices of non-ferrous metals downward. Iron prices reached a peak in November and coal in December, both remaining steady since; copper and lead prices broke in May and tin in July, their indices falling from maxima of 81·5, 126·8 and 253·3 respectively to 52·8, 85·4 and 180·0 in December, since which month there has been, on the whole, little change. All component items of the textiles section except cotton were on average above the 1936 level. The fall in cotton prices which took place early in the year was due to the heavy American crop, but there has recently been a somewhat firmer tendency. Jute and silk prices began to fall in May, wool in August and flax in September. The increases in the sundry materials groups were, on the whole, less than those in the minerals and textile groups, with the exception of timber,* for which demand has been well maintained. The yearly averages for hides and leather are also higher, but prices have eased since the third quarter. As a result of the advance in the three sections, the materials group index rose from 94 in 1936 to 110 in 1937, against a corresponding rise in the food index from 81 to 93. At the end of this article on page 388 the average prices and index numbers for all the commodities comprised in *The Statist* index number are given for the period since 1916; the figures for 1873 are also shown and average prices for four ten-year periods.

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* It was not made clear until late in 1937 that the Board of Trade, when changing from the measurement of pitprops by loads to fathoms in January 1936, and subsequently in January 1937, from fathoms to piled cubic fathoms, intended both fathoms and piled cubic fathoms to mean an open measure of 120 cubic feet of solid wood. All previous calculations by *The Statist* had been made, in conformity with earlier information supplied by the Board and the generally accepted custom of the trade, on the assumption that a fathom and a piled cubic fathom was a solid measure of 216 cubic feet. It has accordingly been necessary to recalculate the average price of timber for the purpose of the Index during the years 1936 and 1937, with corresponding minor revisions of the materials and the total index for every month of these two years.

Monthly Fluctuations of the Index Numbers of* 45 *Commodities*, 1867–77 = 100

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1888	70·9	70·6	69·9	69·8	68·1	67·4	69·0	70·1	71·9	72·4	72·7	73·2	70
1894	65·8	65·0	64·3	63·8	63·1	63·1	62·6	63·0	62·7	61·7	60·8	60·1	63
'95	60·0	60·0	60·8	61·7	62·5	62·4	62·8	63·3	63·5	63·3	62·3	61·2	62
'96	61·4	61·4	60·7	60·3	60·1	59·3	59·2	59·7	61·2	62·6	62·6	62·0	61
'97	62·0	61·9	61·9	61·5	61·2	61·3	61·7	63·2	63·4	62·7	62·4	62·4	62
'98	62·8	63·4	63·0	65·5	66·4	64·7	64·3	64·0	63·9	63·6	63·9	63·8	64
1899	65·4	65·8	65·6	66·1	66·6	66·9	67·9	68·3	70·0	71·5	71·6	72·3	68
1900	74·0	75·1	75·7	75·6	75·5	75·7	76·2	76·0	75·5	74·7	73·9	73·4	75
'01	72·2	71·7	71·0	70·6	70·5	69·8	69·5	69·8	69·6	69·6	69·0	68·4	70
'02	68·8	68·9	69·2	69·7	70·9	70·4	70·0	69·5	69·3	68·8	68·6	69·1	69
'03	69·5	70·2	70·4	69·4	69·6	69·5	69·5	70·0	69·1	69·0	69·0	70·0	69
1904	70·4	70·8	70·8	70·5	69·9	69·4	69·9	70·4	70·7	71·0	71·2	70·9	70
'05	71·2	71·4	71·8	72·0	71·7	72·0	72·5	72·3	72·4	73·2	74·2	74·9	72
'06	75·2	75·0	75·7	76·5	77·0	76·9	76·4	76·7	77·5	78·5	78·6	79·7	77
'07	80·0	80·7	80·0	80·7	82·4	82·0	81·1	79·4	79·1	78·8	76·7	76·2	80
'08	76·0	74·5	74·1	73·8	73·6	72·9	73·1	72·2	72·5	72·2	72·2	72·3	73
1909	72·0	71·9	72·4	74·3	75·4	75·1	75·2	74·9	74·7	75·2	75·5	76·3	74
'10	77·1	78·1	79·1	78·5	78·2	76·9	78·1	78·2	77·6	77·2	77·8	77·9	78
'11	78·5	78·6	78·9	80·0	80·3	80·0	78·9	79·5	80·3	80·7	80·6	80·9	80
'12	81·8	82·9	84·4	85·0	85·3	85·5	86·5	85·9	86·7	85·8	85·3	86·4	85
'13	86·4	86·1	86·7	86·2	85·7	84·1	84·2	85·0	85·7	84·5	83·3	83·8	85
1914	83·5	83·8	82·8	82·3	82·3	81·2	82·4	87·9	89·3	89·8	88·8	91·6	85
'15	96·4	100·9	103·7	105·9	107·2	106·4	106·4	107·0	107·8	110·0	113·1	118·4	108
'16	123·6	127·0	130·4	134·2	135·4	131·0	130·5	134·5	134·4	141·5	150·8	154·3	136
'17	159·3	164·0	169·0	173·0	175·0	180·4	176·9	175·7	176·4	180·6	182·9	185·1	175
'18	186·2	187·3	188·0	189·8	191·1	192·3	192·9	195·9	197·1	197·8	195·3	196·0	192
1919	192·1	187·5	184·7	184·6	194·6	199·4	206·4	212·7	214·8	224·3	231·0	235·2	206
'20	245·3	260·4	261·8	266·1	260·0	255·7	254·6	253·5	248·7	239·9	223·8	207·2	251
'21	197·2	183·0	177·2	169·8	162·2	155·8	158·2	154·3	149·4	138·4	136·7	133·6	155
'22	132·5	132·2	133·3	134·8	135·5	135·6	134·0	129·6	127·9	130·1	130·6	129·1	131
'23	130·2	131·9	132·7	134·0	132·2	127·9	124·8	125·0	127·8	127·7	132·4	133·2	129
1924	137·2	138·8	137·0	136·8	136·4	136·3	138·4	138·0	141·3	146·1	145·5	147·7	139
'25	144·8	143·1	140·1	137·5	135·7	131·2	134·3	134·3	132·7	130·2	132·9	130·4	136
'26	129·3	127·9	126·1	125·5	125·7	124·9	126·0	127·0	128·0	131·0	130·8	123·9	126
'27	123·1	124·1	123·6	123·3	123·8	123·1	122·0	122·8	121·5	120·6	121·5	121·4	122
'28	120·9	121·1	123·6	125·6	126·2	122·6	120·3	118·0	116·8	116·8	117·9	117·9	120
1929	117·0	120·1	120·5	116·5	113·0	113·1	115·2	113·9	112·6	111·1	108·3	108·8	115
'30	106·6	104·8	103·0	101·5	98·8	95·8	94·4	92·2	90·8	90·4	88·6	86·9	97
'31	85·7	85·5	85·5	84·4	82·2	82·6	80·2	79·1	80·7	82·3	83·0	85·4	83
'32	84·7	86·7	84·1	82·5	80·2	77·0	78·9	80·7	80·4	77·8	77·9	77·7	80
'33	77·8	77·0	77·0	78·5	80·9	81·3	81·7	81·2	80·7	80·5	79·3	80·0	79
1934	82·5	82·5	82·2	81·0	81·1	80·7	82·4	83·4	82·1	81·1	81·0	82·8	82
'35	83·6	83·4	82·9	84·1	85·2	83·7	84·3	84·1	85·1	85·8	86·3	86·7	84
'36†	87·1	87·1	86·7	86·2	85·6	84·8	87·1	89·0	90·4	91·7	94·5	98·9	89
'37	99·6†	102·1†	107·3	104·7	106·2	104·7	105·9	104·4	103·3	100·8	96·7	97·3	102
'38	96·5	96·4	94·2										

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* The average of the twelve monthly figures of each year does not necessarily coincide with the annual figures, as the latter are calculated mostly from the average of 52 weekly quotations, while the former are based on end-of-the-month prices.

† Revised.

Summary of Index Numbers. Groups of Articles, 1867–77 = 100

	Vegetable Food (Corn, etc.)	Animal Food (Meat, etc.)	Sugar, Coffee, and Tea	Total Food	Minerals	Textiles	Sundry Materials	Total Materials	Grand Total	Silver *	Wheat Harvest †	Average Price of Consols ‡	Average Bank of England Rate ‡
												£	Percent.
1873......	106	109	106	107	141	103	106	114	**111**	97·4	80	92½	4·750
1896......	53	73	59	62	63	54	63	60	**61**	50 5	112	110¾	2·483
1911......	70	90	61	75	93	76	81	83	**80**	40·4	110	79 5/16	3·467
1912......	78	96	62	81	110	76	82	88	**85**	46·1	97	76 5/32	3·776
'13......	69	99	54	77	111	84	83	91	**85**	45·3	105	73 21/32	4·771
'14......	75	100	58	81	99	81	87	88	**85**	41·6	109	72 1/16	4·038
'15......	108	126	70	170	126	92	109	108	**108**	38·9	106	65½	5·000
'16......	133	152	86	130	158	129	136	140	**136**	50·4	97	58 1/16	5·470
1917......	177	192	113	169	172	192	174	179	**175**	65·8	102	54¾	5·15
'18......	168	207	130	174	192	222	202	206	**192**	76·4	111	56⅞	5·0
'19......	179	213	147	185	220	228	219	222	**206**	85·3	98	54 1/16	5·166
'20......	227	263	198	234	295	262	244	264	**251**	76·1	96	47 1/16	6·71
'21......	143	218	83	158	181	140	145	153	**155**	48·1	118	47 21/32	6·092
1922......	107	184	82	130	142	134	124	132	**131**	51·6	105	56 15/32	3·692
'23......	98	162	101	122	155	140	117	134	**129**	49·4	105	57 63/64	3·496
'24......	119	158	105	130	158	170	120	146	**139**	50·7	107	56 1/64	4·0
'25......	118	162	89	128	154	165	119	143	**136**	52·5	114	56⅜	4·575
'26......	108	150	88	119	154	133	114	131	**126**	47·1	99	54 11/16	5·0
1927......	108	138	83	114	141	131	118	129	**122**	42·8	109	54 33/64	4·650
'28......	107	142	78	114	123	136	117	124	**120**	44·0	109	55 11/16	4·5
'29......	99	146	72	110	126	122	111	119	**115**	40·2	114	54 9/16	5·508
'30......	77	142	54	96	112	84	97	97	**97**	29·0	99	56	3 4
'31......	68	119	50	83	100	63	85	82	**83**	20·4	99	55 1/16	3·975
1932......	72	105	50	79	99	64	81	81	**80**	19·5	105	66 23/32	3·017
'33......	60	106	47	74	107	67	80	83	**79**	18·7	114	73 21/32	2·0
'34......	63	108	50	77	109	72	80	85	**82**	20·0	120	80 11/32	2·0
'35......	66	107	42	76	112	80	83	90	**84**	26·4	112	86½	2·0
'36......	76	109	41	81	118	83	88§	94	**89**§	18·5	100	85 11/64	2·0
'37......	93	117	49	93	142	93	101	110	**102**	18 4	99	76 1/32	2 0
Average 1904–13	68	91	53	73	95	74	76	81	**77**	44·1	106	82 15/16	3·733
1890–99	61	80	63	68	71	56	66	64	**66**	55·8	103	103 1/16	2·958
'78–87	79	95	76	84	73	71	81	76	**79**	82·1	97	99 9/16	3·264
1818–27	109	90	151	111	128	105	106	112	**111**	98·0	—	—	3·692

* Silver (see note on p. 385), parity of 1 gold to 15½ silver = 100.

† Wheat harvest in U K. to 1895 : 29 bushels = 100; from 1896: 30 bushels = 100.

‡ Average price of Consols and the average Bank of England rate of discount are actual figures, not index-numbers; Consols 3% to 1888, 2¾% from 1889, 2½% from April, 1903.

§ Revised.

THE STATIST'S *Index Numbers—monthly averages by groups*
(1867–77 = 100)

	Vegetable Food	Animal Food	Sugar, Tea, and Coffee	Foodstuffs	Minerals	Textiles	Sundry Materials	Total Materials	All Commodities
1935									
Jan. ...	64·6	112·7	42·2	**77·6**	110·1	77·1	81·6	**87·9**	**83·6**
Feb. ...	64·5	112·0	40·7	**77·0**	107·4	77·8	83·3	**88·0**	**83·4**
March ...	64·0	108·9	40·9	**75·7**	109·1	77·2	82·9	**88·2**	**82·9**
April ...	65·4	108·8	42·6	**76·6**	112·0	78·8	83·0	**89·6**	**84·1**
May ...	70·1	108·1	42·6	**78·3**	113·4	79·6	83·1	**90·2**	**85·2**
June ...	65·7	106·9	41·7	**75·8**	111·6	79·7	82·3	**89·4**	**83·7**
July ...	68·9	105·4	40·1	**76·3**	114·4	80·5	81·6	**90·1**	**84·3**
Aug. ...	67·5	108·3	39·8	**76·7**	111·9	81·5	81·1	**89·5**	**84·1**
Sept. ...	70·1	106·0	41·8	**77·4**	115·2	78·4	84·2	**90·8**	**85·1**
Oct. ...	70·6	104·4	42·7	**77·1**	116·4	80·7	85·1	**92·2**	**85·8**
Nov. ...	69·2	103·9	41·6	**76·1**	117·4	85·3	85·0	**93·4**	**86·3**
Dec. ...	72·3	104·1	41·2	**77·4**	116·2	85·8	84·5	**93·3**	**86·7**
1936 *									
Jan. ...	73·4	104·8	41·9	**78·4**	114·9	84·9	86·2	**93·5**	**87·1**
Feb. ...	71·9	104·9	41·0	**77·6**	116·9	84·1	86·7	**94·0**	**87·1**
March ...	71·0	104·1	40·8	**76·8**	116·6	84·7	86·3	**94·0**	**86·7**
April ...	73·4	102·3	40·9	**77·2**	116·7	81·4	85·9	**92·8**	**86·2**
May ...	71·2	108·7	39·6	**78·3**	114·7	79·1	84·2	**90·8**	**85·6**
June ...	69·1	110·4	38·5	**77·9**	112·7	77·7	84·2	**90·0**	**84·8**
July ...	69·3	114·0	38·9	**79·4**	114·5	80·7	87·5	**92·7**	**87·1**
Aug. ...	76·4	112·1	39·1	**81·7**	115·6	79·6	91·7	**94·4**	**89·0**
Sept. ...	80·3	111·8	39·4	**83·3**	119·9	81·1	90·8	**95·6**	**90·4**
Oct. ...	83·9	111·2	40·8	**84·9**	122·8	84·7	88·8	**96·7**	**91·7**
Nov. ...	84·0	110·5	41·9	**84·9**	129·9	87·6	93·6	**101·5**	**94·5**
Dec. ...	89·6	110·5	45·0	**87·9**	136·2	92·4	99·1	**107·0**	**98·9**
1937									
Jan. ...	91·3	108·1	46·2	**88·0**	134·5	95·9	100·3	**108·1**	**99·6**
Feb. ...	91·1	111·5	46·7	**89·3**	144·8	96·1	101·6	**111·5**	**102·1**
March ...	97·0	118·4	48·3	**94·6**	153·5	100·2	104·9	**116·5**	**107·3**
April ...	96·3	120·1	48·5	**95·0**	138·5	100·0	103·7	**111·8**	**104·7**
May ...	95·6	121·8	50·2	**95·7**	146·1	100·9	102·7	**113·8**	**106·2**
June ...	90·9	121·2	50·2	**93·5**	145·9	98·9	102·2	**112·9**	**104·7**
July ...	92·9	123·3	50·5	**95·2**	149·4	97·6	102·7	**113·7**	**105·9**
Aug. ...	92·4	121·7	49·5	**94·2**	148·0	95·1	100·9	**111·8**	**104·4**
Sept. ...	94·5	119·2	50·5	**94·3**	145·8	91·0	100·7	**109·9**	**103·3**
Oct. ...	96·4	117·6	49·0	**94·2**	138·6	85·4	99·3	**105·6**	**100·8**
Nov. ...	94·4	114·0	47·1	**91·7**	135·5	78·7	93·7	**100·3**	**96·7**
Dec. ...	95·7	117·2	45·6	**93·1**	134·7	79·5	93·8	**100·4**	**97·3**
1938									
Jan. ...	95·0	115·2	44·2	**91·7**	135·0	79·4	92·8	**100·0**	**96·5**
Feb. ...	92·0	117·1	42·7	**90·9**	136·2	78·6	93·7	**100·5**	**96·4**
Mar. ...	89·9	116·9	42·3	**89·8**	133·3	75·5	90·6	**97·4**	**94·2**

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* Indices for "sundry materials," "total materials" and "all commodities" revised for 1936 and Jan.–Feb. 1937.

Quarterly Movements of Prices *

Summary of Index Numbers, 1867–77 = 100

Years	Quarters	Vegetable Food (Corn, etc.)	Animal Food (Meat, etc.)	Sugar, Coffee, and Tea	Total Food	Minerals	Textiles	Sundry Materials	Total Materials	Grand Total	Silver †
1926	I	103·9	152·4	86·8	118·1	150·3	148·8	147·7	134·8	**127·8**	50·6
	II	104·1	155·0	88·4	119·5	148·0	135·7	113·7	129·7	**125·4**	49·3
	III	106·8	154·2	88·2	120·3	166·1	126·4	114·1	131·9	**127·0**	47·4
	IV	109·3	144·4	88·9	117·9	192·0	115·8	115·9	136·4	**128·6**	41·2
'27	I	108·1	143·4	85·4	116·1	155·0	120·7	118·3	128·9	**123·6**	43·0
	II	111·6	145·9	82·6	118·1	140·7	127·9	118·2	127·2	**123·4**	43·0
	III	106·9	138·1	80·8	112·9	133·3	139·8	118·1	128·8	**122·1**	42·1
	IV	104·5	132·1	82 0	110·0	132·8	138·6	120·6	129·5	**121·2**	43·3
'28	I	108·9	143·8	80·3	115·7	123·6	136·7	120·6	126·3	**121·9**	43·2
	II	118·0	152·0	81·1	122·8	122·9	140·6	117·9	126·3	**124·8**	44·7
	III	101·1	142·0	77·9	111·2	121·0	135·3	116·7	123·6	**118·4**	44·3
	IV	101·9	138·1	76·3	109·8	126·0	131·5	115·3	123·5	**117·5**	43·7
'29	I	102·9	142·7	75·4	111·8	130·2	130·7	116·6	124·6	**119·2**	42·8
	II	92·8	148·3	73·2	109·1	125·0	121·2	111·1	117·9	**114·2**	41·1
	III	99·9	143·4	71·7	110·0	126·9	115·6	111·1	116·7	**113·9**	39·6
	IV	91·3	145·2	64·2	105·4	122·9	107·9	108·7	112·3	**109·4**	37·3
'30	I	80·8	152·1	58·3	102·3	121·1	96·4	104·9	106·7	**104·8**	33·0
	II	76·7	142·4	56·5	96·5	110·8	92·4	99·5	100·4	**98·7**	29·8
	III	77·4	132·1	48·6	91·5	109·0	77·3	94·6	94·6	**92·5**	26·8
	IV	71·9	130·0	51·7	89 0	105·4	68·9	91·6	88·3	**88·6**	26·5
'31	I	69·0	127·3	48·6	86·2	103·4	62·7	89·8	85·1	**85·6**	21·8
	II	69·5	123·3	48·8	85·0	98·6	61·4	85·6	81·7	**80·1**	21·3
	III	70·0	117·4	47·0	81·4	98·5	58·6	81·6	79·0	**83·0**	21·9
	IV	75·7	107·9	53·7	82·9	102·2	66·9	85·4	84·1	**83·6**	21·5
'32	I	80·7	109·2	52·2	83·2	101·1	67·5	87·8	85·2	**85·2**	21·0
	II	77·6	107·6	50·2	82·9	95·1	59·4	79·6	77·3	**79·9**	19·4
	III	68·2	105·3	49·6	77·9	100·6	65·9	80·7	81·5	**80·0**	19·4
	IV	64·2	98·2	48·4	73·4	101·2	64·5	80·2	81·0	**77·8**	18·4
'33	I	60·2	106·0	47·3	74·4	99·7	62·0	79·1	79·4	**77·3**	18·2
	II	59·1	108·4	47·4	74·8	109·7	68·7	79·8	84·2	**80·2**	20·0
	III	62·0	105·8	47·9	75·2	111·0	71·0	80·0	85·6	**81·2**	18·5
	IV	58·5	106·4	47·4	73·8	110·9	67·7	79·7	84·4	**79·9**	18·5
'34	I	59·4	110·1	53·0	76·7	111·7	73·6	79·9	86·5	**82·4**	19·1
	II	58·7	110·3	52·2	76·1	108·4	70·8	79·1	84·4	**80·9**	18·6
	III	71·0	109·5	48·0	80·4	108·5	70·7	78·7	84·3	**82·6**	19·7
	IV	66·7	107·3	44·8	77·0	109·7	70·9	79·6	85·0	**81·6**	22·1
'35	I	64·4	111·2	41·3	76·8	108·9	77·4	82·6	88·0	**83·3**	23·0
	II	67·1	107·9	42·3	76·9	112·3	79·4	82·8	89·8	**84·3**	29 3
	III	68·8	106·6	40·6	76·8	113·8	80·1	82·3	90·1	**84·5**	27·3
	IV	70·7	104·1	41·8	76·9	116·7	83·6	84·9	93·0	**86·3**	25·7
‡'36	I	72·1	104·6	41·2	77·6	116·1	84·6	86·4	93·8	**87·0**	18·2
	II	71·2	107·1	39·7	77·8	114·7	79·4	84·8	91·2	**85·5**	18 6
	III	75·3	112·6	39·1	81·5	116·7	80·5	90·0	94·2	**88·8**	18·6
	IV	85·8	110·7	42·6	85·9	129·6	88·2	93·8	101·7	**95·0**	18·9
'37	I	93·1	112·7	47·1	90 6	144·3	97·4	102·3	112·0	**103·0**	18·6
	II	94·3	121·0	49·6	94·7	143·5	99·9	102·9	112·8	**105·2**	18·7
	III	93·3	121·4	50·2	94·6	147·7	94·6	101·4	111·8	**104·5**	18·4
	IV	95·5	116·3	47·2	93·0	136·3	81·2	95·6	102·1	**98·3**	18·0

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* The averages of the four quarterly figures to each year do not necessarily coincide with the annual averages, as the latter are based as far as possible on average weekly prices. See also the *Journal*, 1893, p. 221; 1895, p. 144; 1901, p. 90; and 1909, p. 70.

† Silver, parity of 1 gold to 15½ silver = 100.

‡ Quarterly indices for "sundry materials," "total materials" and "all commodities" revised for 1936.

Construction of the Tabular Statements

The following table illustrates the method of construction of the index numbers. The index numbers here given are based on the average prices for the eleven years 1867–77. Take, for instance, the *Gazette* price of English wheat :—

	s.	*d.*	
Average, 1867–77 ...	54	6	= 100, average point.
,, 1914 ...	35	0	= 64, or 36 per cent. *below* the average point.
,, 1920 ...	80	7	= 148, ,, 48 ,, *above* ,, ,,
,, 1926 ...	53	3	= 98, ,, 2 ,, *below* ,, ,,

The individual index numbers, therefore, represent simple percentages of the average point.

The articles are grouped in six categories :—

		1867–77 Total Numbers	Example for 1937	
			Total Numbers	Average
1. Vegetable food, corn, etc. (wheat flour, barley, oats, maize, potatoes, and rice) ...	8 Index nos.	800	745	93
2. Animal food (beef, mutton, pork, bacon, and butter) ...	7 ,,	700	820	117
3. Sugar, coffee, and tea	4 ,,	400	195	49
1—3. *Food*	19 ,,	1,900	1,760	93
4. Minerals (iron, copper, tin, lead, and coal)	7 ,,	700	995	142
5. Textiles (cotton, flax, hemp, jute, wool, and silk) ...	8 ,,	800	745	93
6. Sundry materials (hides, leather, tallow, oils, soda, nitrate, indigo, and timber) ...	11 ,,	1,100	1,112	101
4—6. *Materials*	26 ,,	2,600	2,852	110
General Average	45 ,,	4,500	4,612	102

The general average is drawn from all forty-five descriptions, which are treated as of equal value, and is the simple arithmetical mean as shown above.

Index of Silver Prices

The base of the index numbers given below is 1 gold to 15½ silver = 100, 60·84*d.* per standard ounce being parity.*

	Price per oz. standard	Index number		Price per oz. standard	Index number
	d.			*d.*	
Average 1873 ...	59¼	=97·4	*Lowest* Nov., 1902	21$\frac{11}{16}$	=35·6
,, '90–99...	34	=55·8	End Dec., 1906 ...	32$\frac{5}{16}$	=53·1
,, 1917–26...	40½	=66·6	,, Dec., '08 ...	23$\frac{3}{16}$	=38·1
,, 1893 ...	35⅝	=58·6	,, Dec., '12 ...	29	=47·7
,, '96 ...	30¾	=50·5	,, Dec., '13 ...	26$\frac{9}{16}$	=43·7
,, 1909 ...	23$\frac{11}{16}$	=38·9	,, June, '14 ...	26	=42·7
,, '14 ...	25$\frac{5}{16}$	=41·6	,, Dec., '14 ...	22$\frac{11}{16}$	=37·3
,, '15 ...	23$\frac{11}{16}$	=38·9	,, Dec., '15 ...	26¼	=43·1
,, '16 ...	31$\frac{5}{16}$	=50·4	,, Dec., '16 ...	36½	=58·7
,, '17 ...	40⅞	=65·8	,, Dec., '17 ...	43½	=70·0
,, '18 ...	47½	=76·4	,, Dec., '18 ...	48$\frac{7}{16}$	=77·9
,, '19 ...	57	=85·3	,, Dec., '19 ...	77¼	=98·3
,, '20 ...	61$\frac{9}{16}$	=76·1	,, Dec., '20 ...	40⅞	=49·2
,, '21 ...	36⅞	=48·1	,, Dec., '21 ...	34⅝	=49·3
,, '22 ...	34$\frac{7}{16}$	=51·6	,, Dec., '22 ...	31$\frac{9}{16}$	=49·6
,, '23 ...	31$\frac{15}{16}$	=49·4	,, Dec., '23 ...	33$\frac{7}{16}$	=49·0
,, '24 ...	34	=50·7	,, Dec., '24 ...	31$\frac{11}{16}$	=50·4
,, '25 ...	32⅛	=52·5	,, Dec., '25 ...	31$\frac{11}{16}$	=52·1
,, '26 ...	28$\frac{11}{16}$	=47·1	,, Dec., '26 ...	25	=41·1
,, '27 ...	26$\frac{1}{32}$	=42·8	,, Dec., '27 ...	26½	=43·6
,, '28 ...	26¾	=44·0	,, Dec., '28 ...	26⅜	=43·3
,, '29 ...	24$\frac{7}{16}$	=40·2	,, Dec., '29 ...	21$\frac{7}{16}$	=35·2
,, '30 ...	17$\frac{11}{16}$	=29·0	,, Dec., '30 ...	14$\frac{7}{16}$	=23·7
,, '31 ...	14⅜	=20·4	,, Dec., '31 ...	20$\frac{7}{16}$	=21·6
,, '32 ...	17⅞	=19·5	,, Dec., '32 ...	16½	=17·2
,, '33 ...	18⅛	=18·7	,, Dec., '33 ...	19$\frac{3}{16}$	=19·5
,, '34 ...	21$\frac{7}{32}$	=20·0	,, Dec., '34 ...	24	=22·6
,, '35 ...	29	=26·4	,, Dec., '35 ...	22½	=20·6
,, '36 ...	20$\frac{1}{16}$	=18 5	,, Dec., '36 ...	21$\frac{5}{16}$	=19·4
,, '37 ...	20$\frac{1}{16}$	=18·4	,, Dec., '37 ...	19$\frac{1}{16}$	=17·7

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* All the index numbers in the table from 1916 to 1925 inclusive and from 1931 to date are calculated on the basis of the gold prices of silver instead of the sterling prices, though the latter are the price quotations given in the table. In arriving at the index numbers for these dates the prices of gold are taken as follows. For 1916, 1917 and 1918 the price is taken as 86*s.* 9½*d.* per fine oz., derived from the "pegged" New York rate of \$4·76½ to the £. For 1919 the average price of gold is taken as 93*s.* 4¼*d.*, this being the parity price with the U.S. dollar, the average New York exchange in that year being \$4·429. For the other dates the index numbers are based on the quotations in the London market for exportable gold. The quotation at the end of 1919 was 109*s.* 8¼*d.* per fine oz. At the end of 1920, 1921, 1922, 1923 and 1924 the quotations per fine oz. were 116*s.* 1*d.*, 98*s.* 0*d.*, 88*s.* 11*d.*, 95*s.* 4*d.*, and 88*s.* 2*d.* respectively and the average quotations in these years were 112*s.* 11½*d.*, 107*s.* 0½*d.*, 93*s.* 4*d.*, 90*s.* 3*d.*, and 93*s.* 8¼*d.* respectively, while the average price in 1925 was 85*s.* 5½*d.* The prices at the end of 1931, 1932, 1933, 1934, 1935, 1936 and 1937 were 121*s.* 11*d.*, 123*s.* 9*d.*, 126*s.* 6*d.*, 141*s.* 0*d.*, 141*s.* 2*d.*, 141*s.* 7*d.* and 139*s.* 6*d.* respectively, and the average prices in these years were 92*s.* 6¼*d.*, 118*s* 0¾*d.*, 124*s.* 10½*d.*, 137*s.* 7¾*d.*, 142*s.* 1¼*d.*, 140*s.* 3½*d.* and 140*s.* 8¾*d.* respectively.

World's Production of Silver (in millions of ounces)

	United States	Mexico	Canada	Australia	Other Countries	Total
1902... ...	55·5	60·2	4·3	8·0	34·8	162·8
'03... ...	54·3	70·5	3·1	9·7	30·1	167·7
'04... ...	57·7	60·8	3·7	14·5	27·5	164·2
'05... ...	56·1	65·0	5·9	15·0	30·3	172·3
'06... ...	56·5	55·2	8·5	14·2	30·6	165·0
'07... ...	56·5	61·0	12·8	19·0	34·8	184·2
'08... ...	52·4	73·6	22·1	17·2	37·8	203·1
'09... ...	54·7	73·9	27·5	16·3	39·7	212·1
'10... ...	57·1	71·4	32·9	21·5	38·8	221·7
'11... ...	60·4	79·0	32·7	16·6	37·5	226·2
'12... ...	63·8	74·6	31·6	18·1	36·2	224·3
'13... ...	66·8	70·7	31·5	3·5	51·4	223·9
'14... ...	72·4	27·5	28·4	3·6	36·5	168·4
'15... ...	74·9	39·5	28·4	4·1	37·3	184·2
'16... ...	74·4	38·2	25·4	4·2	26·6	168·8
'17... ...	71·7	35·0	22·2	10·0	35·3	174·2
'18... ...	67·8	62·5	21·2	10·0	35·9	197·4
'19... ...	56·7	62·7	15·7	7·4	32·0	174·5
'20... ...	55·5	66·8	12·6	7·5	33·0	175·4
'21... ...	53·1	64·5	13·1	4·9	35·7	171·3
'22... ...	56·2	81·1	18·6	11·3	46·3	213·5
'23... ...	73·3	90·9	17·8	13·3	50·7	246·0
'24... ...	65·3	91·5	19·7	10·8	52·2	239·5
'25... ...	66·1	92·9	20·2	11·1	54·8	245·1
'26... ...	62·7	98·3	22·4	11·2	59·0	253·6
'27... ...	60·4	104·6	22·7	9·0	57·3	254·0
'28... ...	58·4	108·5	21·9	9·0	59·5	257·3
'29... ...	61·2	108·7	23·1	9·0	59·7	261·7
'30... ...	51·0	105·0	26·0	8·9	57·1	248·0
'31... ...	31·0	86·0	21·0	7·6	50·4	196·0
'32... ...	24·0	69·0	18·0	6·5	47·5	165·0
'33... ...	22·8	68·1	15·2	11·0	52·0	169·1
'34... ...	32·5	74·1	16·4	10·8	56·6	190·4
'35... ...	45·6	75·6	16·6	11·4	71·5	220·7
'36... ...	63·4	77·5	18·2	12·0	80·3	251·4
'37...* ...	68·0	88·0	24·0	95·0		275·0

* Provisional. (Estimate by Messrs. Samuel Montague & Co.).

As the table shows, the average price of silver in 1937 was lower than that of 1936, itself considerably below the price of any previous year. From December 1935 purchases by the United States Treasury in the London market were restricted, and buying was on a very spasmodic scale in both 1936 and 1937; in addition, the International Silver Agreement of 1933 came to an end last year, and uncertainty as to whether American purchases could be continued carried the price heavily down in December. World production (figures for which are taken from Annual Reports of the United States Director of the Mint) was again in excess of the previous year, as is indicated in the table above.

Gold.—The table below shows the world's annual gold production since 1850. Prior to 1911 the estimates are those of the Bureau of the U.S. Mint and other authorities. The estimates since 1926 are those of the Union Corporation Limited. The value is taken throughout at £4·25 per fine oz. The figures show clearly the increase in output caused by the departure of the large producing countries from the gold standard (especially the departure of South Africa at the end of 1932).

(000's omitted)

Year	Value of output £
1850	11,600
'51	17,200
'52	26,550
'53	31,090
'54	25,490
'55	27,015
'56	29,520
'57	26,655
'58	24,930
'59	24,970
'60	23,850
'61	22,760
'62	21,550
'63	21,390
'64	22,600
'65	24,040
'66	24,220
'67	22,805
'68	21,945
'69	21,245
'70	21,370
'71	25,400
'72	24,200
'73	23,600
'74	22,950
'75	22,700
'76	22,540
'77	23,830
'78	22,020
'79	21,400
'80	22,130
'81	21,150
'82	20,500
'83	20,640
'84	20,830
'85	21,250
'86	21,430
'87	21,735
'88	22,644
'89	25,375
'90	24,421
'91	26,846
'92	30,134
'93	32,363
1894	37,229
'95	40,843
'96	41,559
'97	48,509
'98	58,949
'99	63,027
1900	52,312
'01	53,630
'02	60,975
'03	67,337
'04	71,380
'05	78,143
'06	82,707
'07	84,857
'08	90,995
'09	93,302
'10	93,544
'11	94,930
'12	95,783
'13	97,481
'14	92,709
'15	97,114
'16	92,597
'17	87,236
'18	78,605
'19	73,078
'20	68,522
'21	67,848
'22	66,723
'23	77,888
'24	81,807
'25	82,267
'26	82,211
'27	82,582
'28	82,400
'29	84,500
'30	88,500
'31	95,100
'32	103,400
'33	107,700
'34	116,000 *
'35	125,700 *
'36	140,300 *
'37 (provisional)	150,900

* Amended figures.

Average Prices of Commodities *

No. of Article	0	1	2	3	4	5	6	7	8	1–8	9	10
		Wheat		Flour	Barley	Oats	Maize §	Potatoes *	Rice	Vegetable Food	Beef ‡	
Year	Silver †	English *Gazette*	American	Town Made white (now "G.R.")	English *Gazette*	English *Gazette*	American Mixed	Good English	Rangoon Cargoes to Arrive	Total	Prime	Middling
	d. per oz.	*s.* and *d.* per qr.	*s.* and *d.* per qr.	*s.* per sack (280 lbs.)	*s.* and *d.* per qr.	*s.* and *d.* per qr.	*s.* per qr.	*s.* per ton	*s.* and *d.* per cwt.		*d.* per 8 lbs.	*d.* per 8 lbs.
1873 ...	59¼	58·8	63	51	40·5	25·5	30	160	9·6	—	65	56
1917 ...	40⅞	75·9	83·3	58½	64·10	51·7	71¾	186½	25·3	—	104½	101
'18 ...	47½	72·9	78·7	46¾	59·0	49·3	78⅖	142¾	26·2	—	103	103
'19 ...	57	72·10	74·10	46¾	75·8	52·3	78⅕	198⅓	25·10	—	108	108
'20 ...	$61\frac{9}{16}$	80·7	92·4	66	90	57·4	90⅔	242½	41·10	—	125	125
'21 ...	36⅞	72·9	73·9	64½	54·4	34·5	38⅓	198	18·5	—	115	109⅞
'22 ...	$34\frac{7}{16}$	47·10	52·11	45¾	40·1	29·1	31¼	130	14·10	—	88⅝	82
'23 ...	$31\frac{15}{16}$	42·2	47·3	39½	33·8	26·8	36	101	14·10	—	79¼	74½
'24 ...	34	49·3	53·9	43⅚	46·9	27·2	39⅔	186	16·9	—	82⅛	76⅛
'25 ...	32⅛	52·2	62·4	50⅛	42·0	27·2	$38\frac{9}{16}$	154	16·0	—	80	73½
'26 ...	$28\frac{11}{16}$	53·3	58·9	49¼	36·11	25·1	$29\frac{13}{16}$	127	16·3	—	74	67
'27 ...	$26\frac{1}{32}$	49·3	58·3	$44\frac{9}{16}$	42·0	25·4	$30\frac{9}{16}$	136	15·11	—	70	62
'28 ...	26¾	44·8	50·10	40⅙	39·0	29·0	$38\frac{15}{32}$	133	15·0	—	74	66½
'29 ...	$24\frac{7}{16}$	42·2	51·3	38½	35·5	24·7	36¼	111	14·3	—	71	66
'30 ...	$17\frac{11}{16}$	34·3	36·10	$33\frac{1}{12}$	28·3	17·2	23	93	13·0	—	73	68
'31 ...	14⅗	24·0	25·1	22⅞	28·0	17·8	$15\frac{9}{16}$	146	9·8	—	67	61
'32 ...	$17\frac{27}{32}$	25·0	27·5	$24\frac{7}{32}$	27·1	19·3	$18\frac{13}{16}$	152	9·8	—	65	59
'33 ...	18⅛	22·10	25·7	$23\frac{23}{32}$	28·7	15·10	$17\frac{1}{16}$	86	7·9	—	61	52
'34 ...	$21\frac{7}{32}$	20·2	28·0	23⅕	30·11	17·5	$19\frac{19}{32}$	97	7·8	—	58	52
'35 ...	29	22·2	31·1	25¾	28·7	18·9	17¼	107	8·10	—	54	49
'36 ...	$20\frac{1}{16}$	30·9	35·1	$31\frac{17}{32}$	29·5	17·8	19½	146	9·0	—	54	50
'37 ...	$20\frac{1}{16}$	40·0	49·7	40⅓	39·0	23·11	$26\frac{9}{16}$	136	10·5	—	61	57
Average												
1904–13	26¾	31½	36	30	25½	18½	24½	78	7¾	—	51	44½
1890–99	34	28½	31½	27½	25⅛	17½	19½	72	6¼	—	47	37½
'78–87	50	40	43½	34½	31½	21	25	102	8	—	55½	46
'67–77	58½	54⅓	56	46	39	26	32½	117	10	–	59	50
	Index Numbers (or Percentages) of Prices, the Average of 1867–77 being 100											
1873 ...	97·4	108	113	104	104	98	92	137	95	851	110	112
1917 ...	65·8	139	149	127	166	199	221	160	252	1,413	177	202
'18 ...	76·4	134	140	102	151	190	241	122	262	1,342	174	207
'19 ...	85·3	134	134	102	194	201	242	170	258	1,435	183	216
'20 ...	76·1	148	165	143	231	221	279	207	418	1,812	212	250
'21 ...	48·1	133	132	140	139	132	118	169	184	1,147	195	220
'22 ...	51·6	88	95	100	103	112	96	111	148	853	150	164
'23 ...	49·4	77	84	86	86	103	111	86	148	781	134	149
'24 ...	50·7	90	96	95	120	105	122	159	167	954	139	152
'25 ...	52·5	96	111	109	108	105	119	132	160	940	136	147
'26 ...	47·1	98	105	107	95	96	92	109	163	865	125	134
'27 ...	42·8	90	104	98	108	97	95	116	159	867	119	124
'28 ...	44·0	82	91	87	100	112	118	114	150	854	125	133
'29 ...	40·2	77	91	84	91	95	112	95	143	788	120	132
'30 ...	29·0	63	66	72	72	66	71	79	130	619	124	136
'31 ...	20·4	44	45	50	71	68	48	125	93	544	114	122
'32 ...	19·5	46	49	53	69	74	58	130	93	572	110	118
'33 ...	18·7	42	46	52	73	61	53	74	78	479	103	104
'34 ...	20·0	37	50	50	79	67	60	83	77	503	98	104
'35 ...	26·4	41	56	56	73	72	53	91	88	530	92	98
'36 ...	18·5	56	63	69	75	68	60	125	90	606	92	100
'37 ...	18·4	73	89	88	100	92	82	116	105	745	103	114

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* The annual prices are the average monthly or weekly quotations, except potatoes, which are the average weekly quotations during the eight months January to April and September to December.

† Not included in the general average. ‡ Meat (9—13), by the carcase, in the London Central Meat Market.

§ La Plata from 1924.

Average Prices of Commodities—Contd.

No. of Article	11	12	13	14	15	9–15	16A	16B	17	18A*	18B*	18
	Mutton		Pork	Bacon	Butter		Sugar			Coffee		
Year	Prime *d.* per 8 lbs.	Middling *d.* per 8 lbs.	Large and Small, average *d.* per 8 lbs.	Waterford *s.* per cwt.	Friesland, Fine to Finest *s.* per cwt.	Animal Food Total	British West Indian Refining ‖ *s.* per cwt.	Beet, German, 88 p. c., f.o.b. *s.* per cwt.	Java, Floating Cargoes § *s.* per cwt.	Ceylon Plantation, Low Middling † *s.* per cwt.	Rio, Good *s.* per cwt.	Mean of 18A and 18B
1873 ...	71	63	54	81	123	—	$22\frac{1}{2}$	25	28	100	86	—
1917 ...	$114\frac{3}{5}$	$109\frac{2}{5}$	$110\frac{1}{5}$	148	216	—	$31\frac{1}{2}$	$25\frac{3}{8}$‡	$32\frac{3}{4}$	$94\frac{3}{4}$	58	—
'18 ...	$109\frac{1}{5}$	$109\frac{3}{5}$	$128\frac{4}{5}$	183	$247\frac{2}{5}$	—	33	$26\frac{1}{2}$‡	$35\frac{1}{2}$	$128\frac{2}{5}$	69	—
'19 ...	114	114	128	$190\frac{1}{3}$	252	—	$38\frac{2}{5}$	$34\frac{1}{3}$‡	$43\frac{1}{2}$	$145\frac{3}{4}$	$114\frac{7}{8}$	—
'20 ...	$144\frac{2}{3}$	$144\frac{2}{3}$	$168\frac{1}{4}$	$239\frac{2}{3}$	301	—	58	$65\frac{1}{2}$†	$74\frac{3}{4}$	148	$111\frac{1}{2}$	—
'21 ...	$130\frac{7}{8}$	$125\frac{1}{4}$	$121\frac{4}{5}$	179	250	—	$19\frac{1}{2}$	$18\frac{1}{2}$‡	22	$120\frac{3}{4}$	63	—
'22 ...	125	$121\frac{2}{5}$	101	$145\frac{1}{3}$	$202\frac{1}{2}$	—	15	$14\frac{1}{8}$	$15\frac{5}{16}$	$120\frac{2}{3}$	$74\frac{1}{3}$	—
'23 ...	$114\frac{3}{8}$	$107\frac{3}{4}$	89	$113\frac{3}{4}$	186	—	$25\frac{1}{2}$	$23\frac{1}{3}$	$24\frac{2}{3}$	$117\frac{1}{2}$	55	—
'24 ...	$111\frac{1}{2}$	$103\frac{1}{2}$	70	106	211	—	$23\frac{3}{8}$	$20\frac{1}{4}$	$21\frac{1}{2}$	$152\frac{5}{8}$	$85\frac{1}{3}$	—
'25 ...	$106\frac{3}{8}$	$98\frac{5}{8}$	$84\frac{1}{2}$	$128\frac{1}{2}$	$206\frac{7}{8}$	—	$16\frac{1}{4}$	$11\frac{5}{8}$	$12\frac{1}{3}$	$153\frac{13}{16}$	$98\frac{5}{16}$	—
'26 ...	89	$80\frac{1}{2}$	$98\frac{5}{8}$	130	173	—	$16\frac{7}{12}$	$11\frac{2}{3}$	$12\frac{5}{8}$	$154\frac{2}{3}$	$89\frac{1}{16}$	—
'27 ...	86	$79\frac{3}{5}$	85	$102\frac{1}{4}$	178	—	$16\frac{7}{16}$	$12\frac{1}{2}$	$13\frac{9}{16}$	$143\frac{1}{2}$	$71\frac{1}{2}$	—
'28 ...	$92\frac{1}{4}$	87	77	$101\frac{3}{4}$	$185\frac{7}{8}$	—	$13\frac{1}{2}$	$10\frac{11}{16}$	$11\frac{1}{2}$	$143\frac{9}{32}$	$81\frac{11}{32}$	—
'29 ...	$89\frac{1}{2}$	83	91	$116\frac{13}{32}$	$180\frac{1}{8}$	—	$11\frac{7}{32}$	$8\frac{5}{16}$	$8\frac{7}{8}$	$141\frac{1}{8}$	$74\frac{27}{32}$	—
'30 ...	92	86	89	$105\frac{5}{8}$	$146\frac{13}{16}$	—	$8\frac{5}{8}$	$5\frac{27}{32}$	$6\frac{13}{32}$	$106\frac{23}{32}$	$42\frac{11}{32}$	—
'31 ...	79	73	65	$83\frac{3}{8}$	130	—	$7\frac{13}{16}$	$5\frac{11}{16}$	$6\frac{7}{16}$	$101\frac{1}{4}$	$33\frac{15}{16}$	—
'32 ...	63	55	54	77	$126\frac{3}{8}$	—	$7\frac{1}{2}$	$5\frac{5}{16}$	$5\frac{19}{32}$	$105\frac{3}{32}$	$54\frac{5}{16}$	—
'33 ...	69	63	60	$81\frac{1}{2}$	$105\frac{9}{16}$	—	$7\frac{5}{32}$	$4\frac{23}{32}$	$5\frac{1}{4}$	$86\frac{25}{32}$	$42\frac{1}{8}$	—
'34 ...	74	70	65	$90\frac{9}{32}$	$79\frac{3}{8}$	—	$6\frac{5}{32}$	$4\frac{5}{32}$	$4\frac{11}{16}$	$87\frac{7}{32}$	$42\frac{13}{16}$	—
'35 ...	75	70	62	89	$92\frac{5}{8}$	—	$6\frac{3}{16}$	$3\frac{21}{32}$	$4\frac{3}{4}$	$67\frac{9}{16}$	$29\frac{21}{32}$	—
'36 ...	73	68	65	$93\frac{27}{32}$	$98\frac{21}{32}$	—	$6\frac{13}{32}$	$3\frac{19}{32}$	$4\frac{3}{4}$	$58\frac{1}{2}$	$30\frac{21}{32}$	—
'37 ...	78	74	68	94	$108\frac{3}{32}$	—	$7\frac{31}{32}$	$5\frac{1}{4}$	$6\frac{1}{2}$	$75\frac{3}{4}$	$36\frac{3}{4}$	—
Average												
1904–13	$58\frac{1}{4}$	$51\frac{3}{4}$	$47\frac{5}{8}$	67	113	—	$10\frac{1}{8}$	$10\frac{7}{8}$	12	$75\frac{1}{2}$	$43\frac{3}{4}$	—
1890–99	$54\frac{1}{2}$	$41\frac{1}{2}$	$42\frac{3}{4}$	59	100	—	$11\frac{1}{2}$	$11\frac{1}{2}$	$13\frac{3}{4}$	98	62	—
'78–87	$64\frac{1}{2}$	53	49	71	116	—	17	18	$21\frac{1}{2}$	78	52	—
'67–77	63	55	52	74	125	—	23	24	$28\frac{1}{2}$	87	64	—
	Index Numbers (or Percentages) of Prices, the Average of 1867–77 being 100											
1873 ...	113	114	104	109	98	760	101		98	*115	*134	125
1917 ...	182	199	212	200	173	1,345	121		115	109	91	100
'18 ...	174	199	248	247	198	1,447	127		125	148	110	129
'19 ...	181	207	246	258	202	1,493	155		153	167	180	174
'20 ...	230	263	324	324	241	1,844	263		262	170	174	172
'21 ...	208	228	234	242	200	1,527	81		77	140	98	119
'22 ...	199	221	194	196	162	1,286	62		54	140	116	128
'23 ...	182	196	171	154	149	1,135	104		87	135	86	111
'24 ...	177	188	135	143	169	1,103	93		75	175	133	154
'25 ...	169	180	162	174	165	1,133	60		43	176	154	165
'26 ...	141	146	190	176	138	1,050	60		44	178	139	159
'27 ...	136	145	163	138	142	967	62		47	165	112	139
'28 ...	146	158	148	137	149	996	51		40	165	127	146
'29 ...	142	151	175	157	144	1,021	42		31	162	117	140
'30 ...	146	155	171	143	117	992	31		22	123	66	95
'31 ...	125	133	125	113	104	836	29		23	120	53	87
'32 ...	100	100	104	104	101	737	27		20	121	85	103
'33 ...	110	114	115	110	84	740	25		18	100	66	83
'34 ...	117	127	125	122	64	757	22		16	100	67	84
'35 ...	119	127	119	120	74	749	21		17	78	46	62
'36 ...	116	124	125	127	79	763	21		17	67	48	58
'37 ...	124	135	131	127	86	820	28		23	87	57	72

* Index numbers not included in general average.
† East India good middling from 1908.
§ Raw Centrifugals, 96 per cent. Pol., from 1924.
‡ Comparative values.
‖ White Javas, C.I.F., from 1924.

Average Prices of Commodities—Contd.

No. of Article	19A*	19C*	19B*	19	16–19	1–19	20A	20B	21	22	—	23
	Tea				Sugar, Coffee, and Tea		Iron			Copper		Tin
Year	Congou, Common	Indian, Good Medium	Average Import Price	Mean of 19A and 19B	Total	Food Total	Scottish Pig	Cleveland (Middlesbrough) Pig	Bars, Common	Standard	English Tough Cake	Straits
	d. per lb	*d.* per lb	*d.* per lb				*s* and *d* per ton	*s* and *d* per ton	per ton	£ per ton	£ per ton	£ per ton
1873 ...	12	—	16·67	—	—	—	117·3	—	12½	84	92	132
1917 ...	16⅞	15¼	14·68†	—	—	—	95·7	89·7	13¾	124¾	136¼	238
'18 ...	20⅞	16	15·0	—	—	—	101·0	95·0	14	115½	126	331
'19 ...	13½	15	15 5	—	—	—	143·1	137·1	19⅓	92	99½	257
'20 ...	11¼‡	9⅔	14·97	—	—	—	214·11	208·11	28⅓	97½	112¾	302
'21 ...	4⅜	7	12 4	—	—	—	168·6	137·4	19⅛	69⅓	72⅗	171
'22 ...	8⅝	13⅔	14·9	—	—	—	99·10	90·7	11⅙	63⅓	66⅓	162
'23 ...	11	17 1/16	17·58	—	—	—	108·0	108·9	11⅞	65 9/16	69 15/16	206
'24 ...	9¼	17¾	19 0	—	—	—	96 8	88·2	12½	63 1/16	67 7/16	251
'25 ...	7⅞	14 15/16	18 34	—	—	—	83·4	72·8	11⅞	61 11/16	65½	267
'26 ...	7 13/16	16 15/16	18 82	—	—	—	87·2	87·6	11½	58 1/32	63 5/32	297 9/16
'27 ...	6¾	14⅜	18 58	—	—	—	80·5	73 0	11¼	55¼	60 1/16	303⅞
'28 ..	6 5/16	12¼	16 84	—	—	—	69 9	65 9	9 15/16	63¾	66 3/16	229 7/16
'29 ...	6 1/16	11 7/32	16·11	—	—	—	74·0	70·3	9¾	75 1/16	78⅓	207 7/16
'30 ...	5 7/32	9¼	15 12	—	—	—	76 0	67 0	9 31/32	54¾	58 15/32	144 29/32
'31 ...	4 13/16	6 1/16	13·29	—	—	—	71·0	58·6	10 5/32	38⅛	39 5/16	121⅛
'32 ...	4 9/32	5 29/32	10 75	—	—	—	68 2	58 6	10	31 3/32	33 1/16	140
'33 ...	6 21/32	8 23/32	11 87	—	—	—	66	62·3	9 11/16	32 7/32	34 13/16	202½
'34 ...	8 21/32	12	13·20	—	—	—	69·6	66·11	9 17/32	30 9/32	32 3/32	232¼
'35 ...	6 23/32	10 11/32	13·06	—	—	—	70·6	67·10	9⅝	32 1/16	34 1/16	230 1/32
'36 ...	6¼	11⅝	13·19	—	—	—	78·6	73·2	10 3/16	37 13/32	41 7/32	207 31/32
'37 ...	6 9/16	13 11/32	14·58	—	—	—	104 6	94 4	12 5/16	54 21/32	59½	246¾
Average												
1904–13	7⅞	7⅛	8⅛	—	—	—	57¾	51½	6⅞	67¾	72	164⅞
1890–99	4⅝	7½	9¾	—	—	—	47	41½	5½	50	53	81
'78–87	6¾	—	12¾	—	—	—	46	38	5½	55	60	89
'67–77	11¼	—	17¼	—	—	—	69	60	8¼	75	81	105

Index Numbers (or Percentages) of Prices, the Average of 1867–77 being 100

Year	19A*	19C*	19B*	19	16–19	1–19	20A	20B	21	22	—	23
1873 ...	*107	—	*97	102	426	2,037	170	—	152	112	—	126
1917 ...	150	—	85	117	453	3,211	144		166	166	—	227
'18 ...	186	—	87	137	518	3,307	152		170	154	—	315
'19 ...	120	—	90	105	587	3,515	217		234	123	—	245
'20 ...	100	—	88	94	791	4,447	329		343	130	—	288
21 ...	39	—	72	55	332	3,006	237		232	92	—	163
'22 ...	77	—	86	82	326	2,465	148		136	84	—	154
'23 ...	98	—	102	100	402	2,318	168		144	88	—	196
'24 ...	82	—	110	96	418	2,475	143		152	84	—	239
'25 ...	70	—	106	88	356	2,429	121		144	82	—	254
'26 ...	69	—	109	89	352	2,267	135		139	77	—	283
'27 ...	60	—	108	84	332	2,166	119		136	74	—	289
'28 ..	56	—	98	77	314	2,164	105		120	85	—	219
'29 ...	54	—	93	74	287	2,096	112		118	101	—	198
'30 ...	46	—	88	67	215	1,826	111		121	73	—	138
'31 ...	42	—	78	60	199	1,579	100		123	52	—	115
'32 ...	38	—	62	50	200	1,509	98		121	43	—	131
'33 ...	58	—	68	63	189	1,408	99		117	44	—	193
'34 ...	77	—	77	77	199	1,459	106		116	40	—	221
'35 ...	60	—	76	68	168	1,447	107		117	43	—	219
'36 ...	56	—	76	66	162	1,531	118		123	50	—	198
'37 ...	58	—	85	72	195	1,760	154		149	73	—	235

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* Index numbers not included in the general average. † Approximate. ‡ Nominal.

Average Prices of Commodities—Contd.

}	24 Lead	25A Coal	25B	26	20–26 Minerals	27 Cotton	28	29A Flax	29B	30A Hemp	30B	31 Jute
	English Pig £ per ton	Wallsend Hetton in London § s. per ton	Newcastle Steam s. per ton	Average Export Price s. per ton	Total	Middling American d. per lb.	Fair Dhollerah ‖ d. per lb.	Petrograd ¶ £ per ton	Russian Average Import Price £ per ton	Manila Fair Roping £ per ton.	Petrograd Clean (a) £ per ton	Good Medium †† £ per ton
...	23 1/2	32	—	20·90	—	9	6 3/16	47 1/2	44	43	36	18
...	32 3/8	27 1/2*	30	27·16	—	16·55	13 5/8	113 1/4	151 5/8†	84 3/8	105 1/2	39 3/8
...	32 3/8	33·6	33 1/2	30·6	—	22·3	17 1/8	120‡	156 3/8	99 3/8	166 7/8	39 1/4
...	29 3/8	45·3	45 3/8	46·2	—	19·65	14 3/4	120‡	174 3/8	58 3/4	147 3/8	50 1/8
...	40	32	51 1/8	79·8	—	23·14	13 2/3	120‡	345 1/8	65 3/5	145 1/3	44 1/5
...	24 1/5	32 1/4	29	34·83	—	9·4	5 13/16	112 1/2	118 1/3	40 1/4	145‡	27 5/8
...	25 1/5	34 2/5	24 5/8	24·16	—	12·10	8	95	84 7/8	33 1/5	57‡	30 3/4
...	28 13/32	32 13/32	28	25·13	—	15·25	10	83 3/8	84 1/2	33 1/4	57	26
...	35 13/16	27 1/2	22 3/32	23·38	—	16·26	11·03	120	104 1/2	44	81	31 3/4
...	37 7/16	29 5/8	16 15/16	20·08	—	12·64	11·01	92 1/5	120 3/4	46 1/8	89 1/4	49 9/16
...	32 1/8	**30 7/24	**16 5/24	18·59	—	9·40	7·75	65	72 15/16	43	74 5/8	43 7/8
...	25 9/16	23 1/10	14 13/16	17·80	—	9·54	8·27	95 13/16	74 1/12	43 3/8	66 5/16	32 3/4
...	22 5/16	21 7/16	13 21/32	15·67	—	10·92	8·66	98 1/2	91 15/16	37 11/16	63 13/32	33 13/16
...	24 1/32	23 3/8	15 27/32	16·13	—	10·26	7·73	76 7/16	71 7/32	37 7/32	61	32
...	19 1/2	24 23/32	14 7/32	16·64	—	7·49	5·12	53 1/8	60 7/32	26 1/2	48 7/32	20
...	14 9/32	24 5/8	13 3/4	15·98	—	5·90	4·60	36	35 9/16	18 3/4	27 1/2	15 15/16
...	13 5/16	23 13/32	13 5/8	16·27	—	5·24	4·85	45 7/32	42 5/32	18 23/32	36	16 3/32
...	13 1/4	22 5/8	13 25/32	16·08	—	5·54	4·53	51 13/32	48 15/32	15 7/8	37	14 7/8
...	12 13/32	20 1/4	14 7/32	16·08	—	6·70	4·80	60 11/16	50 29/32	14 29/32	42 5/16	14 3/32
...	16	20 9/32	14 13/32	16·30	—	6·71	5·42	79 3/4	72 5/16	19 11/32	43 1/4	16 15/16
...	19 15/32	23 3/32	15 29/32	16·98	—	6·71	5·12	63 25/32	60 15/16	28 11/32	42 27/32	17 19/32
...	24 29/32	24 1/2	20 29/32	19·05	—	6·21	4·80	78 13/32	70 3/32	34 5/16	38 3/8	19 11/16
ge 3	15 5/8	18 1/8	11 7/8	11 7/8	—	6 1/2	5	32 1/2	36 7/8	30 3/8	31 3/8	18 7/8
)9	12	17 1/2	10 3/8	10 3/8	—	4 1/4	3	27	27	26 1/2	25	12 1/2
37	14	16 3/4	8 5/8	9	—	6	4 1/4	33	34	35 1/2	26 1/2	15
'7	20 1/2	22	12 1/2	12 1/2	—	9	6 3/4	46	48	43	35	19

Index Numbers (or Percentages) of Prices, the Average of 1867–77 being 100

	24	25A	25B	26	20–26	27	28	29A–29B	30A–30B	31
...	117	145	—	167	989	100	92	97	101	95
...	158	125	—	217	1,203	183	201	282	243	207
...	158	153	—	245	1,347	248	253	294	341	207
...	143	206	—	370	1,538	218	219	313	264	264
...	195	145	—	638	2,068	257	203	495	270	236
...	118	147	—	279	1,268	104	86	246	237	145
...	123	156	—	193	994	134	118	191	116	162
...	139	147	—	201	1,083	169	148	179	116	137
...	175	125	—	187	1,105	181	163	239	160	167
...	183	135	—	161	1,080	140	163	227	174	261
...	157	138	—	149	1,078	104	115	147	151	231
...	125	105	—	142	990	106	123	181	141	172
...	109	97	—	125	860	121	128	203	130	178
...	117	106	—	129	881	114	114	157	126	168
...	95	113	—	133	784	83	76	121	96	105
...	71	112	—	127	700	66	68	76	58	84
...	65	106	—	130	694	58	72	93	70	85
...	65	103	—	129	750	62	67	106	68	78
...	61	92	—	129	765	74	71	119	73	74
...	78	92	—	130	786	74	80	161	80	89
...	95	105	—	136	825	74	76	133	91	93
...	121	111	—	152	995	69	71	158	93	104

pproximate prices. † Approximate. ‡ Nominal. § Best Yorkshire house after 1916.
ow No. 1 Oomra, Fine. ¶ Livonian Z.K. from 1921. ** Average price January–April, 1926.
· Lightnings from 1931. (a) Russian Sirets Group 1, Sort 1 from 1931–33; Jugo-Slav Peasant from 1934.

Average Prices of Commodities—Contd.

No. of Article	32A	32B	33	34	27–34	35A	35B	35C	36A	36B	37
	Wool			Silk		Hides			Leather		Tallow
Year	Merino, Port Phillip, Average Fleece d.* per lb.	Merino, Adelaide, Average Greasy d. per lb.	English, Lincoln Half Hogs d. per lb.	Tsatlee † s. per lb.	Textiles Total	River Plate, Dry d. per lb.	River Plate, Salted d. per lb.	Average Import Price d. per lb.	Dressing Hides d. per lb	Average Import Price d. per lb.	Town s. per cwt.
1873 ...	25	$11\frac{3}{4}$	$24\frac{1}{2}$	$21\frac{3}{4}$	—	11	$8\frac{1}{4}$	—	$18\frac{1}{4}$	—	44
1917 ...	$46\frac{1}{2}$	$23\frac{1}{4}$	$20\frac{7}{8}$	$21\frac{1}{2}$	—	20	16	15·52	35	$34\frac{1}{2}$	$62\frac{1}{4}$
'18 ...	$47\frac{1}{4}$	$23\frac{1}{2}$	$18\frac{3}{4}$	$25\frac{3}{4}$	—	$20\frac{1}{8}$	$13\frac{7}{8}$	15·9	$32\frac{3}{4}$	$32\frac{3}{4}$	$81\frac{7}{8}$
'19 ...	67	$32\frac{1}{8}$	$22\frac{5}{8}$	26	—	$22\frac{1}{2}$	$19\frac{3}{8}$	17·1	$36\frac{1}{2}$	$40\frac{5}{8}$	$87\frac{15}{16}$
'20 ...	$79\frac{7}{8}$	32	22	$38\frac{3}{5}$	—	$20\frac{1}{2}$	$18\frac{1}{4}$	20·1	$43\frac{2}{5}$	$71\frac{1}{4}$	75
'21 ...	$31\frac{7}{8}$	$11\frac{5}{8}$	$8\frac{3}{4}$	$26\frac{9}{16}$	—	$9\frac{11}{16}$	$8\frac{7}{8}$	9·58	$25\frac{1}{8}$	$46\frac{1}{4}$	$36\frac{1}{4}$
'22 ...	39	$17\frac{1}{8}$	$9\frac{3}{4}$	$28\frac{3}{4}$	—	$9\frac{1}{8}$	$8\frac{7}{8}$	8·06	$24\frac{1}{3}$	36	$34\frac{5}{8}$
'23 ...	$43\frac{11}{16}$	$20\frac{1}{3}$	12	$24\frac{1}{4}$	—	$9\frac{15}{32}$	$8\frac{3}{16}$	8·23	$23\frac{7}{16}$	$31\frac{7}{16}$	$36\frac{3}{8}$
'24 ...	$53\frac{7}{16}$	$25\frac{1}{2}$	$18\frac{7}{8}$	$23\frac{7}{16}$	—	$10\frac{3}{64}$	$8\frac{5}{8}$	8·63	$22\frac{13}{16}$	$33\frac{7}{8}$	$42\frac{3}{8}$
'25 ...	$41\frac{1}{16}$	$17\frac{3}{8}$	$17\frac{1}{8}$	$18\frac{1}{8}$	—	$11\frac{7}{16}$	$8\frac{13}{16}$	9·87	23	33	$42\frac{1}{4}$
'26 ...	$36\frac{1}{2}$	$16\frac{7}{16}$	15	$15\frac{15}{16}$	—	$10\frac{5}{16}$	8	9·32	$21\frac{1}{5}$	$35\frac{11}{16}$	$38\frac{1}{8}$
'27 ...	$38\frac{1}{16}$	$17\frac{7}{16}$	$15\frac{11}{32}$	$15\frac{7}{16}$	—	$12\frac{5}{16}$	$10\frac{7}{16}$	9·85	$22\frac{13}{16}$	$36\frac{15}{16}$	$33\frac{7}{8}$
'28 ...	37	$17\frac{3}{16}$	$17\frac{29}{32}$	14	—	$15\frac{7}{16}$	$11\frac{29}{32}$	12·09	$23\frac{13}{16}$	$37\frac{7}{16}$	$36\frac{15}{16}$
'29 ...	$35\frac{3}{8}$	$13\frac{1}{32}$	$16\frac{1}{16}$	$13\frac{7}{8}$	—	$10\frac{9}{16}$	$8\frac{1}{4}$	10·80	$19\frac{1}{4}$	$38\frac{1}{4}$	$36\frac{13}{32}$
'30 ...	$18\frac{9}{32}$	$8\frac{11}{32}$	$10\frac{3}{4}$	$10\frac{15}{16}$	—	$6\frac{25}{32}$	$6\frac{1}{2}$	7·80	$18\frac{1}{2}$	$33\frac{1}{2}$	$28\frac{23}{32}$
'31 ...	14·7	7·1	$8\frac{1}{2}$	$8\frac{15}{16}$	—	$5\frac{1}{2}$	$5\frac{9}{16}$	6·12	$17\frac{3}{4}$	$32\frac{1}{2}$	$19\frac{1}{3}$
'32 ...	15·0	7·2	$5\frac{25}{32}$	$8\frac{5}{32}$	—	$4\frac{9}{16}$	$4\frac{3}{4}$	5·47	$17\frac{3}{32}$	$28\frac{7}{8}$	$21\frac{1}{16}$
'33 ...	19·9	9·3	$5\frac{29}{32}$	$6\frac{3}{4}$	—	$5\frac{1}{4}$	$4\frac{11}{16}$	5·65	$17\frac{11}{32}$	$26\frac{29}{32}$	$19\frac{27}{32}$
'34 ...	$21\frac{1}{4}$	10·4	7	$5\frac{7}{16}$	—	$4\frac{13}{16}$	$4\frac{7}{8}$	5·71	$17\frac{1}{2}$	$25\frac{5}{16}$	$17\frac{3}{4}$
'35 ...	20·1	9·5	$7\frac{11}{32}$	$5\frac{15}{32}$	—	$5\frac{5}{32}$	$5\frac{1}{8}$	5·51	$17\frac{1}{2}$	$25\frac{13}{16}$	$24\frac{5}{8}$
36 ...	24·7	12·2	$10\frac{5}{12}$	$5\frac{25}{32}$	—	$6\frac{1}{4}$	6	6·47	$17\frac{1}{2}$	$27\frac{11}{32}$	$23\frac{9}{32}$
'37 ...	26·9	12·7	16·9	$8\frac{7}{16}$	—	$8\frac{21}{32}$	$7\frac{9}{16}$	8·62	$18\frac{9}{32}$	$28\frac{5}{16}$	$23\frac{15}{32}$
Average											
1904–13	$17\frac{3}{8}$	9	$10\frac{7}{8}$	$11\frac{3}{4}$	—	$9\frac{5}{8}$	$7\frac{1}{8}$	$6\frac{7}{8}$	16	17	$31\frac{1}{2}$
1890–99	$13\frac{1}{2}$	$6\frac{1}{2}$	10	$11\frac{1}{2}$	—	$6\frac{1}{4}$	$5\frac{1}{2}$	5	$13\frac{1}{4}$	$13\frac{3}{4}$	25
'78–87	$18\frac{1}{2}$	$8\frac{3}{8}$	$11\frac{3}{4}$	15	—	$8\frac{5}{8}$	$6\frac{3}{4}$	$6\frac{1}{2}$	15	17	$35\frac{1}{2}$
'67–77	$21\frac{1}{4}$	$9\frac{7}{8}$	$19\frac{3}{4}$	23	—	9	7	$6\frac{7}{8}$	16	$18\frac{3}{4}$	45
	Index Numbers (or Percentages) of Prices, the Average of 1867–77 being 100										
1873 ...	118	—	124	95	822	120	—	—	114	—	97
1917 ...	219		106	94	1,535	225			200		139
'18 ...	222		95	112	1,772	218			188		182
'19 ...	315		114	113	1,820	258			222		195
'20 ...	359		111	168	2,099	257			330		167
'21 ...	140		44	115	1,117	123			205		81
'22 ...	180		49	125	1,075	114			174		77
'23 ...	206		61	105	1,121	113			158		81
'24 ...	254		96	102	1,362	119			163		94
'25 ...	188		87	79	1,319	132			161		94
'26 ...	170		76	69	1,063	121			164		85
'27 ...	177		78	67	1,045	142			172		75
'28 ...	174		91	61	1,086	172			176		82
'29 ...	156		81	60	976	129			166		81
'30 ...	86		54	48	669	92			150		64
'31 ...	70		43	39	504	77			146		43
'32 ...	71		29	35	513	66			132		47
'33 ...	94		30	29	534	68			127		44
'34 ...	102		35	24	572	67			123		39
'35 ...	96		37	24	641	69			125		55
'36 ...	119		53	25	646	82			129		52
'37 ...	127		86	37	745	109			134		52

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* Port Philip fleece washed nominal since 1895, exactly in proportion with the value of clean wool.
† Common New Style from 1921 to 1936. China, Extra "A" in 1937.

Average Prices of Commodities—Contd.

No. of Article	38	39	40A	40B	41	42	43	44	45A	45B	35—45	20—45	1—45
	Oil			Seeds	Petroleum *	Soda	Nitrate of Soda	Indigo	Timber		Sundry Materials	Materials	Grand Total
Year	Palm	Olive	Linseed	Linseed	Refined	Crystals		Bengal, Good Consuming	Hewn, Average Import Price.	Sawn or Split, Average Import Price	Total	Total	
	£ per ton	£ per ton	£ per ton	*s.* per qr.	*d.* per gall.	*s.* per ton	*s.* per cwt.	*s.* per lb.	*s.* per load	*s.* per load			
1873 ...	38	43	32	62	15¼	100	15½	6¾	65	62	—	—	—
1917 ...	46	115¾	56½	112¼	16⅛	89¾	25	10¼	97⅝	210	—	—	—
'18 ...	44⅞	198⅕	63½	131⅛	21⅜	82¾	27¼	9	107⅜	271	—	—	—
'19 ...	69 7/16	200†	92¾	139¼	17⅜	118⅛	24⅞	9⅛	137½	232½	—	—	—
'20 ...	69¾	200†	88⅕	157	25⅓	150⅓	24¾	14½	119⅘	261⅞	—	—	—
'21 ...	36 15/16	80†	31 15/16	72 7/16	22 1/16	140	18 15/16	11 7/16	68¾	156 13/16	—	—	—
'22 ...	34⅗	75½†	39⅕	75½	15 5/16	123	14⅓	9⅚	46⅝	117½	—	—	—
'23 ...	36¼	66 9/16	42 15/16	77⅝	13	103	13 7/16	7½	48	131⅛	—	—	—
'24 ...	40 3/16	79 15/16	42⅝	81 3/16	13⅛	101¾	13⅝	6 1/16	49⅘	122	—	—	—
'25 ...	40⅝	73⅔	43¼	80 5/16	13⅛	100	13⅜	5¾	47 15/16	122 13/16	—	—	—
'26 ...	37⅝	79 9/16	32⅛	63 7/16	13	100	13¼	5⅝	48 29/32	107	—	—	—
'27 ...	34¼	102⅝	31¾	64 5/16	13	100	12 9/16	5½	45 7/16	107 9/16	—	—	—
'28 ...	35¾	80 7/16	29⅞	66 15/16	11 11/16	100	10 31/32	5½	45⅞	111 5/32	—	—	—
'29 ...	34 21/32	72	35 15/32	74⅛	12¾	100	10¼	5½	44¾	107 21/32	—	—	—
'30 ...	25¼	52⅛	36⅝	61 15/16	12¾	100	9 27/32	5½	44½	102 3/16	—	—	—
'31 ...	19 7/16	53 9/16	18 3/16	38⅞	11¼	100	9⅛	5½	37 19/32	83⅜	—	—	—
'32 ...	17⅜	57 3/16	17	38 5/16	10½	100	8¾	5½	35½	75 1/16	—	—	—
'33 ...	15 11/16	53 15/16	20¾	39¾	10¼	100	8 11/32	5½	31⅞	75 19/32	—	—	—
'34 ...	13 17/32	62 3/16	21 13/32	42⅜	10 1/32	100	7 13/16	5½	31½	79 13/32	—	—	—
'35 ...	19⅜	61 13/32	24 13/32	43¼	10½	100	7⅝	5½	32¼	73 5/32	—	—	—
'36 ...	19 31/32	70 3/16	28½	48 5/32	10 3/16	100	7⅝	5¾	37 9/16‡	78 27/32	—	—	—
'37 ...	22 9/16	95 23/32	31⅛	54 11/32	10 25/32	100	7 25/32	5¾	58⅜	103 7/32	—	—	—
Average													
1904–13	31¼	43¾	26⅝	49½	6⅝	60	10⅝	3	38	56	—	—	—
1890–99	24½	35	19¼	38	5⅛	53	8¼	4⅜	40	45	—	—	—
'78–87	32½	40	23	46	6⅞	62	12½	6	47	47	—	—	—
'67–77	39	50	30	60	12½*	92	14	7½	60	54	—	—	—
	Index Numbers (or Percentages) of Prices, the Average of 1867–77 being 100												
1873 ...	97	86	105		122 *	109	110	92	111		1,163	2,974	5,011
1917 ...	118	231	187		129	98	178	142	270		1,917	4,655	7,866
'18 ...	115	396	216		170	90	194	124	332		2,225	5,344	8,651
'19 ...	178	400	258		138	128	177	126	325		2,405	5,763	9,278
'20 ...	179	400	272		203	164	177	200	335		2,684	6,851	11,298
'21 ...	95	160	116		177	152	135	158	198		1,600	3,985	6,991
'22 ...	89	151	127		122	134	102	128	143		1,361	3,430	5,895
'23 ...	93	133	134		104	112	96	103	157		1,284	3,488	5,806
'24 ...	103	160	138		105	111	97	84	151		1,325	3,792	6,267
'25 ...	104	147	137		105	109	96	79	150		1,314	3,713	6,142
'26 ...	96	159	106		104	109	95	78	137		1,254	3,395	5,662
'27 ...	88	205	107		104	109	90	76	134		1,302	3,337	5,503
'28 ...	92	161	108		94	109	78	76	138		1,286	3,232	5,396
'29 ...	89	144	122		102	109	73	76	134		1,225	3,082	5,178
'30 ...	65	104	110		102	109	70	76	129		1,071	2,524	4,350
'31 ...	51	108	63		90	109	65	76	106		934	2,138	3,717
'32 ...	45	114	61		84	109	62	76	97		893	2,100	3,609
'33 ...	40	108	67		82	109	60	76	94		875	2,159	3,567
'34 ...	35	124	71		80	109	56	76	97		877	2,214	3,673
'35 ...	50	123	75		84	109	54	76	92		912	2,339	3,786
'36 ...	51	140	85		81	109	54	79	102 ‡		964	2,453	3,984
'37 ...	58	192	95		86	109	56	79	142		1,112	2,852	4,612

* Petroleum average, 1873–77. † Nominal. ‡ Revised.

MISCELLANEA

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The ever-growing volume of material in our subject has necessitated another change of procedure. We cannot, with our present resources, continue to review the whole subject each year. We propose, therefore, to issue an annual bibliography of literature, and, from time to time, to publish articles dealing with special branches of the subject. A subject, advances in which have been dealt with in one year, can, we think, safely be left for a year or two before it is dealt with again.

Before this plan could be carried out, it was necessary to bring our bibliography up to date. The bibliography which follows goes from the end of 1934 up to the middle of 1937, the next one should go up to the middle of 1938. The article by Mr. Cochran on recent work in the analysis of variance can be regarded as typical of the special articles it is, from time to time, intended to publish.

In a bibliography such as this one it is sometimes difficult to know where to draw the line. In the section on "Theory" will be found some papers which might, perhaps, be considered as belonging to the domain of pure mathematics rather than mathematical statistics, but we believe in casting our net rather wide. There is always the chance that a fresh mind may see the importance of some apparently quite abstract piece of theory in relation to more concrete problems and many important advances have been made in this way. The difficulties of inclusion or exclusion are even greater on the applied side. On the economic side particularly we only give one or two references, but this aspect of the subject (see for instance, F(2) and F(3)), is dealt with elsewhere.

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RECENT ADVANCES IN MATHEMATICAL STATISTICS

Recent Work on the Analysis of Variance

By W. G. COCHRAN

PAPERS on the analysis of variance which have appeared recently may be summarized in five sections. (1) *Design of experiments.* The principles underlying the planning and interpretation of experiments with variable material are discussed in Fisher's book *The Design of Experiments*, which has recently reached its second edition. The lay-out of factorial experiments has been comprehensively studied in a number of papers by Yates, who has also introduced new designs for experiments involving a large number of treatments. (2) The *discriminant function method*, an analytical method, due to Fisher, of picking out that linear function of a set of characters which best distinguishes between several groups in which the characters have been measured. This method has already found applications in craniometry, in taxonomy, in plant selection, and in the selection of candidates by intelligence tests. (3) Papers giving advice on the use and extension of the analysis to problems where the simple method is not immediately applicable or where considerable discretion is required. (4) Further applications of the analysis of covariance. This comparatively recent technique attracted a good deal of attention in previous summaries, and papers are still appearing whose chief interest is as an illustration of the wide usefulness of the method. (5) Other applications.

I. *Design of Experiments*

The first comprehensive examination of designs employing confounding which are likely to be useful is given by Yates in (11), and a thorough study of this in conjunction with *The Design of Experiments* will bring the reader up to date on this subject. The results obtained are summarized below.

(*a*) *Confounding of Factorial Experiments in Randomized Blocks.*

In agricultural field experiments the size of block is flexible and the argument for or against confounding is determined mainly by a consideration of the relative efficiencies of experiments with and without confounding, which in turn depends upon the increase in standard error per plot with increasing size of block. A *résumé* of the information on this question is, therefore, relevant. Very little work has, however, been done. Information on this point can be obtained readily from experiments which have been carried out in randomized blocks by finding, as described by Yates in (6), the information which would have been obtained from these experiments had they been completely randomized. For example, an experiment in 8 randomized blocks of 4 plots each gives an estimate of the gain in information by reducing block size from 32 plots to 4 plots, and is relevant to the question of confounding a 2^5 factorial design in blocks of 4 plots. The average information per experiment obtained in the randomized blocks experiments carried out by Rothamsted from 1927 to 1934 is 1·67 as compared with 1 for complete randomization. Pending more data and more detailed examination, this figure may be taken as representative of the average gain due to the reduction of block size by confounding. It indicates that confounding is well worth while.

Factors ABC . . .	Number of Treatments	Size of Block	Interactions Confounded in a Single Replication	Number *
2^3	8	4	*ABC*	1
2^4	16	8	*ABCD*	1
2^4	16	4	{*AB*, *ACD*, *BCD* or	6
			{*AB*, *CD*, *ABCD*	4
2^5	32	8	*ABC*, *ADE*, *BCDE*	5
2^5	32	4	*BD*, *CE*, *ABC*, *ADE*, *ACD*, *ABE*, *BCDE*	5
2^6	64	16	*ABCD*, *ABEF*, *CDEF*	5
2^6	64	8	*ACE*, *BDE*, *BCF*, *ADF*, *ABCD*, *ABEF*, *CDEF*	10
2^6	64	4	*AB*, *CD*, *EF*, *ACE*, *BCE*, *ACF*, *BCF*, *ADE*, *BDE*, *ADF*, *BDF*, *ABCD*, *ABEF*, *CDEF*, *ABCDEF*	5
3^3	27	9	*ABC*	4
3^4	81	9	*ABC*, *ABD*, *ACD*, *BCD*	4
3×2^2	12	6	*BC*, *ABC*	3
3×2^3	24	6	*BC*, *BD*, *CD*, *ABC*, *ABD*, *ACD*, *ABCD*	3
$3^2 \times 2$	18	6	*AB*, *ABC*	4
$3^3 \times 2$	54	6	*AB*, *AC*, *BC*, *ABD*, *ACD*, *BCD*, *ABCD*	4
4^2	16	8	*AB*	9
4^2	16	4	*AB*	3

* Number of replications for a balanced arrangement.

The Table summarizes most of the simpler designs obtained by Yates for factorial experiments with factors at 2, 3 or 4 levels, the aim being, of course, to confound two- and three-factor interactions as little as possible. The letters *A*, *B*, *C* . . . representing factors, are to be read from the left; *e.g.* the *AB* interaction in the $3^2 \times 2$ design is the first order interaction (4 degrees of freedom) between the two factors which occur at three levels each. The results given apply to a single replication only; with several replications different degrees of freedom may be confounded in the different replications, and with sufficient replication we can always arrange that all interactions of a given order and type are confounded equally. This type of arrangement is called a *balanced* one, and has the advantages that the loss of information on the partially confounded interactions is at a minimum and that the computations are easier. For example, with a 2^5 design in blocks of 8 plots, the following arrangement with five replications clearly confounds all second- and third-order interactions equally.

Replications	Interactions confounded
1	*ABC, ADE, BCDE*
2	*ABD, BCE, ACDE*
3	*ACE, BCD, ABDE*
4	*ACD, BDE, ABCE*
5	*ABE, CDE, ABCD*

Since each of the interactions concerned is completely confounded in one out of five replications, one-fifth of the information relative to unconfounded effects has been sacrificed. The minimum number of replications required to obtain complete balance is shown in the last column of the table.

The following example shows the way in which treatments are assigned (before randomization) to blocks in the first replication above:

Block			
I	II	III	IV
(1)	*ab*	*b*	*a*
bc	*ac*	*c*	*abc*
abd	*d*	*ad*	*bd*
acd	*bcd*	*abcd*	*cd*
abe	*e*	*ae*	*be*
ace	*bce*	*abce*	*ce*
de	*abde*	*bde*	*ade*
bcde	*acde*	*cde*	*abcde*

The interaction *ABC*, for instance, is obtained from the differences between the total of blocks III and IV and the total of blocks I and II. To construct this design, the 32 treatments are first divided into two groups of 16 treatments each, such that the difference between the totals of the two groups represents the interaction *ABC*. Thus the first group contains 16 treatments (1), *ab*, *ac*, *bc*, *d*, *abd*, *acd*, *bcd*, *e*, *abe*, *ace*, *bce*, *de*, *abde*, *acde*, *bcde*. These 16 treatments are then subdivided into two groups of 8 treatments, such that the difference between the totals of the two groups is a part of the *ADE* interaction. To do this, we assign to the first eight all treatments with *none* or *two* of the factors *a*, *d* and *e*, and to the second eight all treatments with *one* or *three* of the factors *a*, *d* and *e*. These groups form respectively blocks I and II in the above plan. Blocks III and IV are constructed similarly.

(*b*) *Confounding of High-order Interactions in Latin Squares.*

Yates also investigates in (11) the possibilities of arranging confounded designs in Latin squares. In the Latin square experiments carried out by Rothamsted from 1927 to 1934 the average information per plot was 2·22 times that which would have been obtained by complete randomization. The corresponding figure for randomized blocks was 1·67, so that on this comparison the increase in efficiency over complete randomization is nearly twice as great for the Latin square as for randomized blocks.

As a simple example, consider the confounding of the 2^3 design with treatments (1), n, p, k, np, nk, pk, npk in 4 × 4 Latin squares.

(1)	np	nk	pk
n	p	k	npk
pk	nk	np	(1)
npk	k	p	n

The square shown, in which the first two rows or columns are a complete replication, clearly confounds *NPK* completely with rows and *PK* completely with columns. By interchange of letters, squares can be constructed which confound *NPK* and *NK* or *NPK* and *NP*. Thus with six replications there is a design in three 4 × 4 Latin squares in which $\frac{2}{3}$ of the information is retained on each of the two-factor interactions. It should be noted that the rows and columns of any Latin square must be randomized to obtain an unbiased error, so that the replications within a square in the above example cannot be kept apart from each other in the field.

Arrangements in Latin squares which avoid confounding any first-order interactions are :—

2^3 in two interlaced 4 × 4 Latin squares
2^4, 2^5 or 2^6 in an 8 × 8 Latin square
3^3 or 3^4 in a 9 × 9 ,, ,,

(*c*) *Varietal Trials Involving a Large Number of Varieties.*

For work on plant selection a technique is required to cope with experiments involving, say, 25, or perhaps many more, varieties in which all comparisons between pairs of varieties may be of equal interest. The ordinary Latin square is clearly out of the question, and randomized blocks comparing as many as 25 plots may be expected to be relatively inefficient in eliminating the effects of the major soil irregularities. These difficulties have been partly overcome in the past by selecting one variety as control and dividing the varieties into small groups, each group with the control being laid out as a separate experiment in randomized blocks or a Latin square. Comparisons between varieties not in the same group are possible by comparing each with the control variety in its group, though they are consideraby less accurate than comparisons between varieties in the same group. Alternatively, the control plots may be arranged systematically, *e.g.* by repetition at fixed intervals along a line of plots. In both these cases the efficiency is reduced by the fact that more plots are allotted to the control variety than to any other.

To obtain a reduction of block size, the varieties in any replication must be arranged in a number of small groups, differences between groups being confounded with block differences. The defects of the above methods may, however, be partly avoided by taking different small groups in different replications. This type of design may be described as quasi-factorial, because its structure and analysis are most easily understood by pretending for convenience that the experiment is a factorial one. With 25 varieties, for instance, by re-numbering the varieties by means of two suffixes, 11, 12, 13, . . . 55, we may regard the experiment as a 5 × 5 factorial design which we wish to confound, using blocks of 5 plots. Since main effects are now of no more importance than interactions, we may confound whichever we choose, and it is more convenient to confound the former. With two replications the main effects of each factor may be confounded in a separate replication. Before randomization within blocks the design is as follows (10 blocks of 5 plots each):

1st Replication					2nd Replication				
11	21	31	41	51	11	12	13	14	15
12	22	32	42	52	21	22	23	24	25
13	23	33	43	53	31	32	33	34	35
14	24	34	44	54	41	42	43	44	45
15	25	35	45	55	51	52	53	54	55
1	2	3	4	5	6	7	8	9	10
Blocks					Blocks				

With this design, the reader may verify that the 16 degrees of freedom representing interactions between the two factors are not in any way confounded with block differences. The 4 degrees of freedom representing the main effects of the first factor are, however, completely confounded with blocks in the first replication, and are estimated from the second replication only. Similarly the main effects of the second factor are obtained from the first replication only. It follows that if the reduction in block size brings no decrease in standard error per plot, this design is not as accurate as randomized blocks of 25 plots, since the standard error of any of the 8 degrees of freedom representing main effects is $\sqrt{2}$ times as great as it would be with randomized blocks. The average variance of a varietal comparison is thus: $(16 + 2 \times 8)/24 = \frac{4}{3}$ times as great as with randomized blocks of 25 plots. The reciprocal factor $\frac{3}{4}$, or in general $\frac{p+1}{p+3}$ with p^2 varieties, is called the "efficiency factor" of the arrangement, and tells by how much the variance has to be reduced by the new blocks to make the new arrangement as efficient as randomized blocks.* The various possible designs of this type, including the extension to three replications and to cases in which the number of varieties is not a complete square, will be found in (9). In general, the disadvantage remains that some varietal comparisons are more accurate than others, but the differences are slight.

Arrangements of this type in quasi-Latin squares are discussed in (10). As an example of the very elegant designs which result, consider the following experiment with 3 replications of 25 varieties, arranged in 5×5 quasi-Latin squares (before randomization). The varieties are numbered from 1 to 25.

I					II					III				
1	2	3	4	5	1	13	25	7	19	1	15	24	8	17
6	7	8	9	10	20	2	14	21	8	18	2	11	25	9
11	12	13	14	15	9	16	3	15	22	10	19	3	12	21
16	17	18	19	20	23	10	17	4	11	22	6	20	4	13
21	22	23	24	25	12	24	6	18	5	14	23	7	16	5

The important point about this design is that any pair of varieties occurs once, and only once, in the same row or column. This can be verified at once for variety 1 and any other variety, by examining the composition of the first row and column of each square. It follows that all varietal comparisons must be of equal accuracy; further, the statistical analysis is very easy. This design depends on the existence of a completely orthogonal set of 5×5 Latin squares. Such sets exist for all prime numbers and have also been found for 4, 8 and 9, but not for 6.

(*d*) In the designs described above, the block size has always been a factor of the number of treatments (*e.g.* 3^4 in a 9×9 Latin square). In agricultural field experiments this restriction is usually of minor importance, except that with small fields it may prevent the most efficient *shape* of block being used. In other branches of biological research, however, blocks of a particular size may be the natural unit, or there may be a limit to the possible size. Examples are monozygotic twins, the halves of a leaf and the numbers produced in a litter by animals. Yates has therefore examined in (8) the design of experiments in blocks of any given size. The principle involved is similar to that in the Latin-square design just described—namely, that each pair of treatments occurs equally frequently in the same block. This ensures that all treatment comparisons are of equal accuracy and that the analysis and presentation of results are simple. The main relevant properties of the design are the minimum number of replications for which a design exists, which is sometimes inconveniently large, and the "efficiency factor," and are studied by Yates. Goulden (5) compares the efficiencies of incomplete blocks and ordinary randomized blocks for eight different crops from uniformity trial data. He concludes that the increases in efficiency due to the use of incomplete blocks vary from 20 to 50 per cent. Considering this gain and the greater adaptability of incomplete blocks to irregularly-shaped fields, Goulden recommends their use in field trials.

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* In further work to be published shortly, Yates considers the possibility of recovering some of the loss of information represented in the efficiency factor, by making use of the information about treatment effects contained in the block totals. He has found that where there are no block effects, all but a small percentage of the lost information can usually be recovered, so that even in its most unfavourable case the quasi-factorial design can be made only slightly less accurate than randomized blocks.

Some extensions of the split-plot design deserve mention (11). (1) The arrangement of the sub-plots in a Latin-square formation is possible in certain restricted cases. This may be expected to increase further the accuracy of split-plot comparisons. (2) The use of split-plots for varietal trials with, say, from 8 to 25 varieties. With this number of varieties neither randomized blocks nor the Latin square is particularly suitable, and the special methods available for a large number of varieties have rather low efficiency factors. (3) The superposition of treatments on whole rows and columns of a Latin square. This type of design has been tried in the past, but the principles involved have not previously been clearly stated.

One minor advantage of the randomized block design over the Latin square has been that if for any reason the yields from one block or treatment are missing, or have to be rejected, the statistical analysis takes exactly the same simple form as before. The treatment of the corresponding case with Latin squares is discussed by Yates in (7). When a single row, column or treatment is missing, the remaining pair of factors become partially confounded, but the statistical analysis remains comparatively simple. The methods also apply when a row and a treatment are missing, but no simple analysis has been found when two rows are missing. It is worth noting that a Latin square with one treatment missing, or one row and one treatment missing, is a valid experimental arrangement, and if suitable could be deliberately laid down.

An important task in introducing new designs which involve an unfamiliar process of analysis is to systematize the numerical working in the best possible manner. Full attention has been paid to this in (11).

II. *The Discriminant Function Method*

The problem of classifying, say, a set of skulls, according to period or sex, by means of measurements made on parts of the skulls, is familiar in anthropology. Where a set of skulls have been correctly assigned to, say, two groups by other means, we may expect to gain some information from this classification as to which measurements are likely to be useful in classifying future material of this kind. Two relevant points will be appreciated: (1) some measurements may have practically the same values in both groups, and so be of little use in classifying new material into one or the other; (2) the information supplied by different measurements will not necessarily be independent. The discriminant function method shows how to combine the measurements to form a single index which will best discriminate between the two groups. The index is taken to be a linear function of the measurements, but more complicated functions can be used in exactly the same way as the method of "linear" regression is extended to formulæ non-linear in the independent variate.

The standard method of discriminating between two groups in statistics is to compare the variation between groups with that within groups by means of a t-test. Thus, given a set of measurements $x_1, x_2, \ldots x_r$, we wish to choose multipliers $\lambda_1, \lambda_2 \ldots \lambda_r$ so that the index $\lambda_1 x_1 + \ldots - + \lambda_r x_r$ maximizes the ratio of the variance between groups to that within groups. If there are n objects in each group, the variance between groups is

$$\frac{n}{2} D^2 = \frac{n}{2} (\lambda_1 d_1 + \lambda_2 d_2 + \ldots + \lambda_r d_r)^2$$

where d_1 is the difference between the means of x_1 in the two groups. The variance within groups is

$$S = \sum_{p=1}^{r} \sum_{q=1}^{r} \lambda_p \lambda_q S_{pq}$$

where S_{pq} is the co-variance within groups of x_p and x_q. Differentiating D^2/S with respect to λ_i we have:

$$\frac{2D}{S} \frac{\partial D}{\partial \lambda_i} - \left(\frac{D}{S}\right)^2 \frac{\partial S}{\partial \lambda_i} = 0$$

i.e.

$$\tfrac{1}{2} \frac{\partial S}{\partial \lambda_i} = \frac{S}{D} \frac{\partial D}{\partial \lambda_i} \qquad i = 1, 2, \ldots r.$$

The factor $\frac{S}{D}$ occurs in all equations; thus the solutions $\lambda_{1}, \ldots \lambda_r$ are proportional to the solutions of the equations

$$\tfrac{1}{2} \frac{\partial S}{\partial \lambda_i} = \frac{\partial D}{\partial \lambda_i}$$

i.e.

$$S_{i1}\lambda_1 + S_{i2}\lambda_2 + \ldots + S_{ir}\lambda_r = d_i \qquad i = 1, 2, \ldots r$$

These equations are formally the same as occur in fitting a multiple linear regression, and may be solved in the same way. Having found the relative values of the λ_i, we may construct the index by putting $\lambda_1 = 1$.

To classify a new specimen, we calculate the index for that specimen and assign it to that group whose mean index is nearest. The question now arises: how often will a mistake be made?; that is, how often will the index of a member of one group appear to lie nearer to the mean value in the other group? To answer this, we require the standard deviation of the index, calculated from the variation of the x_i within groups. For any linear function $\lambda_1 x_1 + \ldots + \lambda_r x_r$ with *constant* coefficients, the variance within groups could be estimated by assigning $2(n - 1)d.f.$ to the total variation of the function within groups. This would not, however, be correct for the index chosen, since the λ_i are functions of the x's, and have been chosen so as to minimize the relative effect of the variation within groups. The correct procedure is, however, equally simple. We can construct a quantity y which is completely determined by the group to which it belongs, by giving it the value of $+\frac{1}{2}$ in the first group and $-\frac{1}{2}$ in the second. It may be shown that the equations for finding the λ_i are the usual equations for determining the partial regression coefficients of y on $x_1\, x_2, \ldots\, x_r$, for both species combined; further, that the variance between groups of the index is that part of the variance of y accounted for by its regression on $x_1, \ldots x_r$ and has $r\ d.f.$ Hence the variation of the index *within* groups has $(2n - r - 1)d.f.$ Knowing the standard deviation within groups, we may at once calculate how frequently an index belonging to the first group would appear to lie nearer to the mean of the second group owing to chance variations in the x_i within groups.

A straightforward application of the above method to discrimination between two species of Iris plants has been given by Fisher (13). In a totally different sphere, Travers (15) has applied the method to the selection of managers from salesmen by intelligence tests in a business organization. A variety of tests was given to a group of salesmen and to a group of competent managers, and from the tests which showed differences between the groups an index was constructed for use in the future selection of managers from salesmen. As the managers in the original test were naturally somewhat older than the salesmen, part of the difference between groups might be due to age differences, and the regression on age was therefore removed before finding the index.

Where the material is classified into more than two groups, the method may be applied to a single degree of freedom from the variation between groups. Thus Barnard (12), considering four series of Egyptian skulls, chooses the index by maximizing the regression of the four series on time. Fisher (13) tests the hypothesis that the index i_3 from a third species of Iris divides the difference between the indices i_1, i_2 of the first two species in the ratio 2 : 1. If this were true, the appropriate method of choosing the index would be to maximize the single square $(4i_1 + i_3 - 5i_2)^2$.

An interesting application to plant selection has been indicated by Fairfield Smith (14). There are a number of desirable characters in a variety of wheat, *e.g.* high yield, resistance to disease, baking quality. In an experimental programme for the selection of varieties, it is essential to decide the relative importance to be attached to each of these characters, or, in strictly quantitative terms, to evaluate each in terms of a standard—say x_1. We might perhaps consider, for example, that a consistent increase of 10 in baking score was worth an extra bushel of yield. In interpreting the results of a replicated varietal trial, however, it would not necessarily be correct to score a difference of 10 in the mean baking score of two varieties as worth 1 unit in bushels of yield, because the observed difference is influenced by a large number of non-heritable factors, *e.g.* soil heterogeneity. In short, instead of observing ξ, the true genotypic value of a character, we can only observe

$$x = \xi + t$$

where t represents the non-heritable part of x. We can, however, estimate the variance of the two parts of x, that of t by the intra-varietal variance and that of ξ by subtracting the intra-varietal from the inter-varietal variance. The problem is to find the linear function $y = \lambda_1 x_1 + \lambda_2 x_2 + \ldots + \lambda_r x_r$ of the known values x, which best represents the score

$$\psi = a_1\xi_1 + a_2\xi_2 \ldots + a_r\xi_r$$

i.e. we choose the λ_i to maximize the correlation between y and ψ. This leads to the type of mathematical problem considered above.

III. *Applications*

A number of papers have appeared giving advice on the application of the analysis of variance to practical problems and dealing with some of the difficulties involved in the newer applications. One of the most common of these is that for many types of data, such as, for example, percentages, the variance is not independent of the mean, so that a straightforward analysis might be misleading. This difficulty can often be overcome by a change of scale, the commonest transformations in use being to replace x by $\sqrt{x}$, $\log x$ or $\sin^{-1}\sqrt{x}$, which theoretically equalize the variance when it is proportional to x, x^2 or $x(1-x)$ respectively. Included in these categories are data which might be expected to follow the binomial or Poisson distributions, but in which the appropriate χ^2 tests are regarded with suspicion because of possible heterogeneity. The square root and inverse sine transformations and the general difficulties encountered in interpreting results on the new scale are discussed by Bartlett (16), who also gives some examples of the practical utility of these transformations. He points out a further complication with factorial designs; the scale in which the main effects of different factors may reasonably be regarded as additive may not be either the scale in which the data are originally recorded or the transformed scale.

The difficulties caused by unequal variances also appear when the results of a number of experiments with the same treatments are being summarized. When the individual experiments have different precision, as will commonly be the case, the problem of estimating and testing the mean response to a treatment and of testing its variation from experiment to experiment can no longer be solved by a simple analysis of variance. Cochran (19) discusses the extension of the technique to these cases. In particular, it may be noted that while the efficient estimate of the mean from a number of quantities x_i with known standard deviations σ_i is

$$\hat{\mu} = \sum \frac{x_i}{\sigma_i^2} \Big/ \sum\left(\frac{1}{\sigma_i^2}\right) \quad . \quad . \quad . \quad . \quad . \quad (1)$$

the efficient estimate when we have only estimates $s_i(n_i\ d.f.)$ of the σ_i is the solution of

$$\sum \frac{x_i - \hat{\mu}}{n_i s_i^2 + (x_i - \hat{\mu})^2} = 0 \quad . \quad . \quad . \quad . \quad (2)$$

i.e. we cannot simply replace the weights in (1) by their estimate.

A wide selection of the practical problems which confront the statistician and a wealth of good advice will be found in a paper by Bartlett (17).

IV. *Analysis of Covariance*

The number of recent papers which have been devoted to the analysis of covariance indicates the growing usefulness and popularity of this method. Most of these papers fulfil two objects: they demonstrate the arithmetical calculations necessary to carry out an analysis of covariance, and illustrate the varied uses to which the method may be put.

We will consider, first, papers which the reader may consult for instruction in the calculations involved. Brady (27) gives the details of the analysis with *two* independent variates, and shows how to obtain an exact z-test of the significance of the treatment differences as a whole after eliminating the linear regression on these two variates.* He does not consider the test of significance of the difference between a pair of treatments, but this has been given by Wishart (35). Wishart first presents the calculations for one and two independent variates, illustrating the latter case on Brady's data, and goes on to establish the general formula with any number of independent variates.

In the paper already mentioned, Bartlett (17) discusses the use of covariance in an experiment of the split-plot design. Here it may be necessary to make separate corrections in the main- and sub-plot analyses, but, as Bartlett points out, there is a certain convenience in using the sub-plot regression coefficient for the main-plot adjustments, and this procedure is quite efficient if the two regression coefficients differ little, a point which can, of course, be tested. Bartlett (17) also shows how to obtain appropriate and exact analyses of variance in experiments in which a missing or rejected value occurs in the dependent or independent variate (or in both). Where the value is missing in one variate only, the corresponding value in the other variate must also be estimated, even though a figure is already available for it. Further, Bartlett points out that the estimation of a missing value by the usual method of least squares may itself be regarded as an analysis of covariance in which the independent variate has a value $+1$ for the missing plot and zero everywhere else. Thus the combination of the estimation of a missing value with an analysis of covariance containing *one* independent variate may be treated as an analysis of covariance with *two* independent variates, and the exact test of significance is obtained by the usual methods of analysis of covariance.

The computations required for an analysis of covariance with *three* independent variates are given in detail by Day and Fisher (29) in a paper which provides an admirable text-book example of the handling of a complicated statistical analysis. The original data were supplied by J. W. Gregor, who collected samples of the seed of *Plantago maritima* from 29 different localities in Scotland and grew the plants together in an experimental garden. The 29 localities obtained are classified into three regions, Inland, Coastal and Island, and the coastal region is further subdivided into four types of habitat. Gregor measured, amongst other factors, the length, breadth and thickness of 100 leaves from each locality. The estimated standard deviations within localities of each of these three factors form the raw material for this study, which, it will be noted, is an analysis of *variability*, since it is concerned with estimated standard deviations, and not with individual measurements.

---

* A similar numerical example was previously given by Crampton and Hopkins, *Journal of Nutrition*, Vol. 8, 329–39, 1934. This paper does not, however, contain the exact test of significance of the adjusted treatment effects.

Two points of difficulty arise at once: (1) while the distribution of an estimated standard deviation s based on 99 degrees of freedom will not be far from normal, the variance of s is proportional to σ^2, so that the analysis can hardly be performed directly on the values of s; (2) in natural populations in which the means vary, the standard deviation often shows an association with the mean, and if the association is at all marked, an analysis of standard deviations will merely be repeating the information which is obtained from an analysis of means. In earlier studies of variability an attempt was sometimes made to allow for this correlation by working on the ratio of the standard deviation to the mean. This, the authors point out, assumes, without logical justification, a particular form of relationship, and is analogous to the type of correction of yield for variation in plant density which was used before the introduction of the analysis of covariance.

It was noted in section III of this review that the use of log s in the analysis solves the first type of difficulty. The use of log s, correctly adjusted for its linear regression on log (mean), also provides the correct allowance for the association of standard deviation and mean. The authors go a step further, and adjust the values of log s for its association with the log (mean) of each of the three measurements, length, breadth and thickness, by a partial regression on three independent variates. The other new point in the analysis is that whilst there are three independent variates, there are also three dependent variates (the logs. of the estimated standard deviation of length, breadth and thickness). The analysis is carried out for all the variances and covariances of the dependent variates.

To turn to the applications which can be made of the analysis of covariance, Bartlett (26) gives a brief discussion of these. He distinguishes two main types. In the first, covariance is used to increase the accuracy of treatment comparisons in replicated experiments. Examples of this use are made by Bartlett (25) to experiments on the nutrition of cows, by Miles and Bryan (31) to the elimination of the effects of variations in plant density on the yields of cereals, and by Hutchinson and Panse (30) to experiments on the selection of cotton varieties for resistance to disease.

Hutchinson and Panse's method is an ingenious one; they sow alternate rows of their plots with a susceptible control variety, which is used as an indicator of the liability of the plot to attack. This method must, however, be used with discretion, as the authors point out.

In the second type of application one is interested in examining the dependence of different sets of observations on each other, and possibly also in predicting one set of observations from previous observations. Instances of this type are Brady's data (27), Snedecor's paper (32) on the control of the marking systems in University examinations in mathematics, and Snedecor and Cox's analysis (33) of the relation between the yields of different varieties of maize and the time taken to the first appearance of silks in each variety.

V. *Other Papers*

A paper by Welch (39) concerns the validity of the application of the z-test to randomized blocks and the Latin squares. Fisher has pointed out that a test of significance can be made, free from any assumption of normality in the data, by calculating the value of z for each of the particular set of designs from which the design used was drawn at random. A comparison on these lines of the actual and theoretical z-distribution was made by Eden and Yates,* who found good agreement. The calculation of the value of z for every possible arrangement is, however, usually a lengthy process, and Welch proposes to approximate to the discontinuous z-distribution by a continuous curve. An approximation on the same lines for the t-distribution was previously given by Bartlett.†

Instead of z, Welch considers for convenience the ratio of the treatment sum of squares to the total of the treatment and error sums of squares. In normal theory, this is distributed as

$$CU^{t/2-1}\,(1-U)^{e/2-1}\,dU \quad . \quad . \quad . \quad . \quad (3)$$

where t and e are the numbers of degrees of freedom attributed to treatments and error respectively. In the U-distribution generated by the randomization process, the mean value of U is the same as that given by normal theory, but the variance is not the same for either randomized blocks or the Latin square. Welch approximates to the discontinuous U-distribution by choosing t and e in (3) to give the correct mean and variance. In actual examples the limits of the discontinuous U-distribution will not, except very rarely, be either 0 or 1. The effects of this discrepancy are not taken into account in the approximation, and will unfortunately be most disturbing at the tails, from which the 5 and 1 per cent. values are calculated. Welch compares the results given by normal theory and by his U-distribution in a number of examples, some of them uniformity trial data and some artificially constructed. He finds good agreement in all four cases of randomized blocks, but a striking difference in the significance levels in two of his six Latin squares. These results are insufficient to prove whether there is any consistent difference between normal theory and the randomization test. Welch suggests that an examination of further uniformity trial data would be useful.

---

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MR. BROSTER ON DEMAND CURVES

BY MILTON FRIEDMAN

IN a recent issue of this *Journal* * Mr. E. J. Broster proposes a new method of deriving a statistical demand curve from annual data on the consumption and average price of a commodity. It is the purpose of this note to demonstrate that his method is invalid.

In the usual procedure, the first step is to eliminate the trends in the price and quantity series and to deflate the price series by some index number of general prices. The demand curve is then obtained by fitting a mathematical curve to these adjusted data.

Mr. Broster's procedure differs from this mainly in the introduction of an intermediate adjustment of the observations between the correction for trend and the fitting of a mathematical curve.†

Letting x represent per capita consumption adjusted for trend and y real price, Mr. Broster describes this intermediate step as follows:

> " 1. Arrange the two series in ascending order according to real price, multiply one by the other, and thus obtain the real outlay, xy, in each year (trend due to extraneous factors removed).
>
> " 2. Calculate the five-year moving averages of the x series and the xy series, and divide the latter by the former to obtain the five-year moving averages of the real prices.
>
> " 3. Rearrange the x series in descending order of magnitude, calculate the five-year moving averages, and place this new series in juxtaposition to the moving averages of the price, y, series, *without changing the order, regardless of whether the years correspond or not.*" ‡

The purpose of this adjustment is to obtain a "greater degree of smoothness," so that a curve can be easily fitted. Now, it cannot be denied that the procedure suggested will accomplish this. The difficulty is that it does it too well. No matter whether the original data on quantity consumed and its average price be positively correlated, negatively correlated, or entirely uncorrelated, the third step must necessarily yield a pair of series showing perfect negative relationship. Moreover, the serial correlation introduced by ordering the series before pairing them is enormously increased by the use of moving averages.* It is inevitable, therefore, that when the final adjusted data are plotted, they not only show a negative relationship, but also trace out an extremely smooth curve.

---

* Vol. C (1937), Part IV, pp. 625–41.

† The other differences are of minor importance. They include, first, the elimination of the trend solely from the quantity data, and, second, the utilization of a somewhat different method to determine the trend in consumption. Mr. Broster lays considerable stress on the second of these and, indeed, suggests that "the means adopted for ascertaining the trend in the quantity series" may be "the fundamental objection" to his method (*ibid.*, p. 639). The sole difference, however, is that Mr. Broster fits the trend by selected points and successive approximations instead of by employing a least squares criterion.

‡ *Ibid.*, p. 631. (Italics his.)

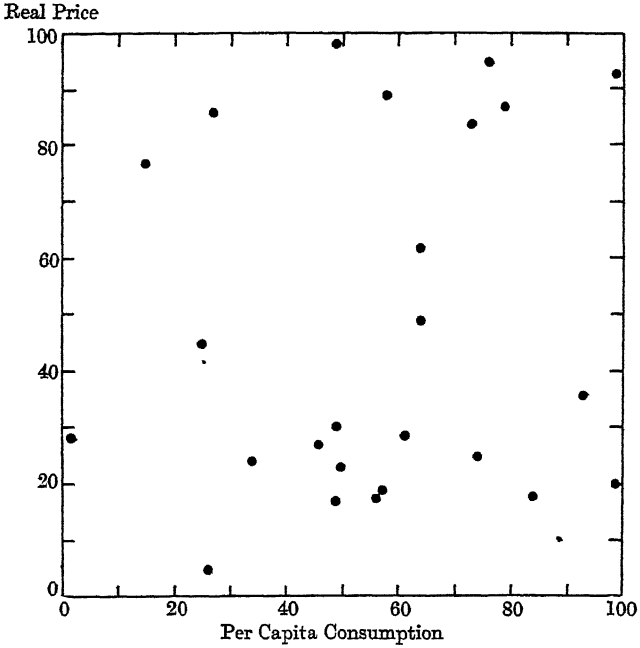

FIG. 1.—Scatter diagram of the real price in each year plotted against per capita consumption. (Data from Table I)

Even if the original data fell precisely on a negatively sloping mathematical curve, the application of Mr. Broster's three steps would not necessarily reproduce the original curve. This arises from essentially the same features of the moving average process as those which explain its well-known tendency to shift turning points.

To illustrate the above remarks—if that be at all needed—two examples follow. In the first, Mr. Broster's technique is applied to two random series and in the second, to data which satisfy the equation of a constant elasticity demand curve.

---

* By serial correlation is meant the correlation between successive observations. The serial correlation between the successive values of a 5-term moving average computed from a series of random observations with equal variances will tend to be 0·80.

The First Example

Table I gives figures for per capita consumption and real price for the period from 1890 to 1914 (the period employed by Mr. Broster). These data were obtained from Barlow's Tables by selecting the fourth and fifth digits after the decimal point of the square roots of every tenth number from 1401 to 1901.* The data are plotted in Fig. 1. No one will claim that there is any correlation between the quantities and the prices.

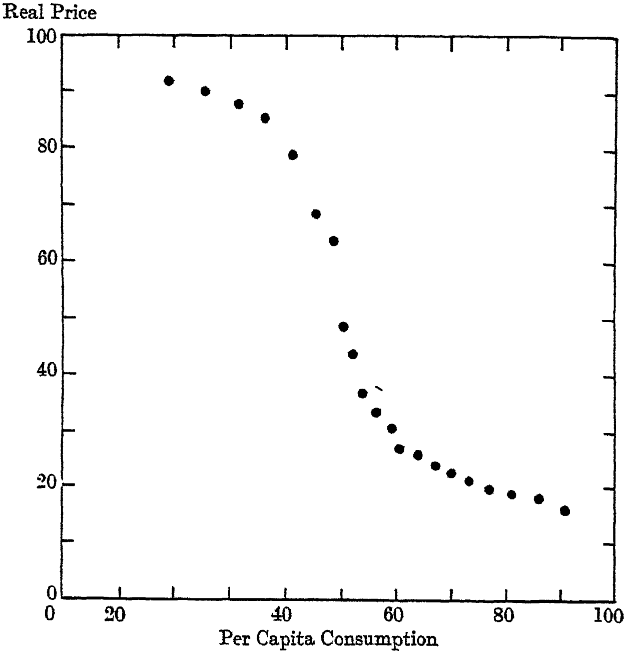

FIG. 2.—Scatter diagram of the five year averages given in Table II

Mr. Broster's three-step formula was applied to these data. The results are shown in Table II and Fig. 2. The "demand curve" traced out by the adjusted data is exceedingly smooth, and could be fitted neatly by an inverted growth curve. It shows high elasticity at high prices, low elasticity at intermediate prices, and high elasticity at low prices—an entirely plausible result for so wide a range of prices as that covered by the data.

---

* The numbers 1521 and 1681 were not used, since they are perfect squares and would have yielded zero values.

TABLE I

Original Data :—Per Capita Consumption and Real Price for Each Year, 1890–1914

(For source of data, see text)

Year	Per Capita Consumption	Real Price	Year	Per Capita Consumption	Real Price
1890	93	36	1903	57	19
1891	27	86	1904	73	84
1892	15	77	1905	49	17
1893	56	18	1906	84	18
1894	50	23	1907	79	87
1895	99	93	1908	34	24
1896	2	28	1909	49	30
1897	61	29	1910	26	5
1898	76	95	1911	64	49
1899	46	27	1912	64	62
1900	74	25	1913	25	45
1901	58	89	1914	49	98
1902	99	20			

TABLE II

Adjusted Data :—Five-Year Moving Averages of Per Capita Consumption and Real Price, from 1890 *to* 1914, *Determined from the Two Series Arranged in Order of Magnitude*

Real Price		Per Capita Consumption	
Year	Cents	Year	Pounds
1910	—	1902	—
1905	—	1895	—
1906	16·8	1890	90·8
1893	18·6	1906	86·2
1903	19·5	1907	81·2
1902	20·4	1898	77·2
1894	21·9	1900	73·2
1908	23·2	1904	70·2
1900	24·8	1912	67·2
1899	26·4	1911	64·0
1896	27·5	1897	60·8
1897	31·4	1901	59·2
1909	33·8	1903	56·4
1890	37·2	1893	54·0
1913	44·2	1894	52·2
1911	48·8	1914	50·6
1912	64·4	1909	48·6
1892	68·8	1905	45·4
1904	79·3	1899	41·0
1891	85·9	1908	36·4
1907	88·4	1891	31·6
1901	90·8	1910	25·4
1895	92·1	1913	19·0
1898	—	1892	—
1914	—	1891	—

The Second Example

The second and third columns of Table III give figures for per capita consumption and real price for a fifteen-year period. These values were computed from the equation* $xy^{0\cdot 5} = 150$. In the fourth and fifth columns of this table are given the adjusted figures. Since the original data already show perfect negative relationship, no rearrangement was necessary. Any failure to reproduce the original curve is thus to be attributed entirely to the moving average process.

TABLE III

Per Capita Consumption and Real Price, 1890–1904
Original and Adjusted Data
(Original Data satisfy equation $xy^{0\cdot 5} = 150$)

Year	Original Data		Adjusted Data	
	Per Capita Consumption	Real Price	Per Capita Consumption	Real Price
1890	2	5625	—	—
1891	3	2500	—	—
1892	4	1406	4	1631
1893	5	900	5	984
1894	6	625	6	663
1895	7	459	7	479
1896	8	352	8	363
1897	9	278	9	285
1898	10	225	10	230
1899	11	186	11	189
1900	12	156	12	158
1901	13	133	13	135
1902	14	115	14	116
1903	15	100	—	—
1904	16	88	—	—

The x values were selected so that the moving average figures for x would be identical with the original observations. In order to see the extent to which the original curve has been distorted, it is thus only necessary to compare the third and fifth columns. The differences introduced by the averaging process are not inconsiderable; they range from slightly more than 15 per cent. in 1892 to approximately 1 per cent. in 1902.

Conclusion

It is evident that Mr. Broster's technique is worthless for deriving statistical demand curves: it will yield "good" results even when there is no "real" demand curve underlying the data and may distort this underlying curve even if it exists.

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* This equation is identical with the one on which curve C C in Mr. Broster's Fig. 2 is based, except that 150 is used instead of 148·8.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

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1.—*Frequency Curves and Correlation.* Third Edition. By W. Palin Elderton. Cambridge, at the University Press, 1938. 8¾″ × 5¾″. 271 pp. 12*s.* 6*d.* net.

The first edition of Sir William Elderton's *Frequency Curves and Correlation* a slim volume of only 172 pp., was published by C. & E. Layton for the Institute of Actuaries in 1906. The second edition, considerably enlarged, was issued by the same publishers in 1927, but, without the imprimatur "Published for the Institute of Actuaries": "the Institute," as the author told us in his preface, "generously handed over the copyright and left me with a free hand as regards the future." Now, the whole of the existing stock having recently been destroyed by fire—a little piece of history only told us on the jacket—a third edition has been published, this time by the Cambridge University Press. What does seem surprising to its old friends is that two editions of a book which was the first English volume solely devoted to modern mathematical methods, which not only was but still is the only one to contain a complete conspectus of Karl Pearson's curves and their methods of fitting, and which ought to be and seems to be familiar to every statistician one meets, should have sufficed for the consumption of thirty years, not to mention the fire.

The first nine chapters, those more specifically on the subjects of the title, have not been essentially altered, but small changes, a few words amended or a new paragraph inserted, are frequent. In Chapters II and III, for example, short paragraphs have been inserted with reference to ungrouped observations, and in Chapter III the text with regard to the summation-method of calculating moments has been revised. In Chapter V there is a new paragraph on a method of avoiding the troublesome work of inverse interpolation in degrees, minutes and seconds for calculating $\tan^{-1}x$, and in Chapter VI (comparison of various systems of curves) there has been a good deal of minor revision.

Chapters X, XI and XII have been rewritten and rearranged. In Chapter X (Standard Errors) the notation and exposition have been greatly improved. In Chapter XI (The Test of Goodness of Fit) the degrees-of-freedom rule is now accepted, though a caution is retained from the former edition. In Chapter XII (Correlation Ratio and Contingency) the changes seem mainly to concern tests of significance, and there is a new short section on Rank Correlation. The concluding Chapter XIII (Partial Correlation) is unaltered, and here the present reviewer would have liked to see a small change. Is it a good example to the student to give, as the sole illustration, one in which the correlations are founded simply on fourfold tables?

Appendix I, on Corrections for Moments, has been largely rewritten, the changes chiefly affecting the portion relating to J-shaped curves. The former Appendix VI, on the Method of Least Squares, now becomes the first part of a much more extensive Appendix V, on Other Methods of Fitting Curves, the new sections dealing with the Method of Maximum Likelihood and the Method of Minimum χ^2. This appendix seems to have been specially enlarged in view of the author adhering to his opinion on the Method of Moments, which the reviewer would endorse: "experience has shown that it is a satisfactory method of fitting a curve to an actual statistical experience. Confirmation on the theoretical side has been produced, and while it is possible to invent other methods of fitting particular curves, as has been done by actuaries in connection with Makeham's law of mortality, no better general method has been produced" (pp. 13, 14). The sentence has been retained from the second edition, unaltered except for one word, the substitution of "confirmation" for "evidence." The references to papers and books in Appendix VIII have been brought well up to date, and the addition to the Tables of short tables of the ordinates and areas of the normal curve and of values of P for certain values of χ^2 and n will considerably increase their usefulness. The book shows only one common symptom of age—a certain increased portliness: there are 271 pp. as against the 172 of the slim volume of 1906 and the 239 of the second edition. But this adds to its dignity and there is no redundant tissue. Succinctness was always a virtue of the work.

It is hardly necessary to say that the volume has been worthily produced by the Cambridge Press, and all those whom the older editions have served for so many years will wish the new one good luck and a long life of usefulness. In view of the many changes, old friends as well as new ones should get a copy. G. U. Y.

2.—*The Theory of Statistical Inference.* By S. S. Wilks. Planographed Lecture Notes, Department of Mathematics, Princeton University, 1937. (Princeton Mathematical Notes, Fine Hall, Princeton, N.J.) $10\frac{3}{4}'' \times 8\frac{1}{2}''$. iii + 106 pp. $1·60 (post paid in advance).

To the historian of statistics a hundred years hence the present time will probably appear as an Age of Discovery. We live at a period of intense development, when new statistical territory is being opened up daily, vast areas of virgin soil are made available for the eager pioneer, and the general field of research is a sort of Tom Tiddler's ground where even the amateur may dig with profit. Against the gratification with which one is tempted to contemplate these happy conditions there must, however, be put the difficulty experienced by the average statistician in keeping abreast of new discoveries and fitting them into his scheme of things. Many of the important contributions to statistical theory of the past thirty years are still hidden away in scientific periodicals. The knowledge is there, but it has hardly been disseminated beyond the lecture-room.

The reasons are evident. Those who are most competent to write a comprehensive treatise on the theory of statistics are too busy adding to that theory themselves; and even if this were not so, research is proceeding so rapidly that any account of modern ideas runs the greatest risk of being out of date before it is dry from the press. We shall probably have to wait many years before some future Euclid gives to our profuse but rather scattered ideas a consistent nomenclature and a coherent scheme of logical development.

In the meantime such notes as these of Dr. Wilks are very welcome. They relate to a set of lectures to graduate students at Princeton, and are an effort "to develop systematically, together with illustrative examples, some of the essential ideas involved in the theory of statistical inference." There are five chapters, dealing respectively with the Elements of Probability, Sampling Theory, The Estimation of Population Parameters, Fiducial Inference and the Neyman–Pearson Theory of Testing Hypotheses.

Dr. Wilks's attitude to Probability is that of the "frequency" school. If, of n events, pn are successes, he assumes that p tends to a limit as n tends to infinity and defines p as the probability of success. Once this difficult hurdle is behind him, he has no trouble in deducing the ordinary laws of probability and showing their relation to statistical populations.

The second chapter, on Sampling Theory, is especially valuable, giving as it does the various methods of obtaining the distributions of specified parameters from given populations—the method of characteristic functions, the geometrical method, and the method of moment equations. Some special distributions, such as that of χ^2, are derived incidentally. If space permitted it might add completeness to this chapter to mention the methods developed by Tschuprow, R. A. Fisher and others for finding the moments of a sampling distribution of moments in terms of those of the parent.

Chapter 3 is devoted to such concepts as efficiency and sufficiency and the method of maximum likelihood in determining optimum estimates. In this connection it is perhaps permissible to call attention to a point of statistical usage on which there seems widespread disagreement, and which would probably appear to the student as an inconsistency. Dr. Wilks points out that a consistent estimate may be biased, adopting the convention that a statistic is unbiased if its mean value is equal to the universe value of the parameter estimated. (So far as one can see, there is no especial reason, other than that of mathematical convenience, for taking the mean value rather than the median or the modal value. But let that pass.) He does not, however, mention that the method of maximum likelihood also gives biased estimates on occasion, although he gives an example of such an estimate.

If the mean and variance of a normal universe are estimated simultaneously, the maximum likelihood estimate of the latter is, with the usual notation, $s^2 = \frac{1}{n} S(\bar{x} - x)^2$, whose mean value is $\frac{n-1}{n} \sigma^2$, not σ^2. The use of the word "optimum" in speaking of such an estimate is obviously liable to be misunderstood. There are better estimates.

In his fourth chapter, Dr. Wilks gives a short account of the problem of inverse probability and of the nature of fiducial inference, and applies the general theory with tests derived from the χ^2 distribution, Student's distribution and Fisher's z-distribution. Finally he gives a valuable sketch of the theory of testing hypotheses recently developed by Dr. Neyman and Professor E. S. Pearson.

These lecture notes are presumably the skeleton of a course of instruction whose flesh and blood would be provided by the lecturer himself. For that reason, and possibly also because the notes are addressed to graduate students who would already be acquainted with the ideas developed, they demand a degree of concentrated attention rare even in statistical work. Dr. Wilks allows himself a full mathematical technique, and he is, in fact, concerned rather with the mathematical development of the consequences of the ideas than with their logical justification. Nevertheless this work will be of considerable service to those wishing to embark on the study of advanced statistical theory. The arrangement of the contents alone is a stimulating piece of classification (no two statistical textbooks resemble each other in their lay out), and constitutes a noteworthy contribution to the rather neglected subject of statistical taxology.

M. G. K.

3.—*Elements of Statistics*. By A. L. Bowley, Sc.D., F.S.S. 6th Edition. London: P. S. King, 1937. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. xv + 503 pp. 18*s*.

The last edition of Dr. Bowley's well-known "Elements" appeared in 1926, and was, with some minor alterations, the same as the fourth edition of 1920. The present edition leaves the main text unchanged, new matter being incorporated either as notes at the ends of chapters or as supplements. Dr. Bowley has wisely not departed from his original design by attempting to cover all the new results of the last sixteen years in this fresh material. He has put "in the simplest possible way those formulæ and ideas which appear to be most useful in the fields of economic and social investigation and of showing their relationship to the treatment followed in the text."

The study of Statistics has been described as a type of mental discipline; and a perusal of some of the journals devoted to social problems suggests that it is a discipline to which many economists could with advantage be subjected. However, this is a free country so far as private reading is concerned, and even the courses of instruction in economics at our universities still leave Statistics as an optional subject. One can only hope that before long every student will be required, for the good of his soul and the collective benefit of social research, to get a grasp of the nature and scope of the tools which he will later have to handle. Such a student would naturally turn to Dr. Bowley's "Elements" in the first instance. M. G. K.

4.—*Seventh Census of Canada, 1931. Volume I, Summary.* Dominion Bureau of Statistics Canada. Ottawa, 1936. 10″ × 7″ 1520 pp. $1·50.

Although this volume bears the date 1936, the Dominion Statistician, our Honorary Fellow, Mr. R. H. Coats, who is responsible for it, informs us under date February 2nd, 1938, that it is "just out." The number of the volume is also misleading, for the six other population volumes, with one exception, have been out long since, and these were preceded by a multitude of bulletins, leaflets, mimeographs, etc., that gave the more important results as they became available. The full report will cover fourteen volumes. The present volume (excluding the contents pages) is in three parts: first the "administrative report" of 68 pages originally issued in 1934; secondly, "an analysis of the main subjects of the present census and of past censuses of Canada," covering 248 pages; and, lastly, 1176 pages of tables.

Canada justly boasts that "the credit of being the first to take a census of population in the modern meaning of the term, belongs to the colony of New France, which in 1666 conducted a 'nominal' or name-by-name enumeration of the people, on the *de jure* principle, of a fixed date, showing age, sex, occupation and conjugal condition." Photographs are given of two of the original sheets of the 1666 census and one of that for 1667, the latter in the handwriting of the great Intendant Calon. Incidentally, these pages show that in those days it was not held indecorous even for a distinguished man to write legibly! The French Governors were obviously keen to measure the progress of their colony, for no fewer than 36 censuses were taken during their rule. It is of historical interest that a section (pages 133–153) is included in this volume revising and considerably extending a chronological statement originally issued in 1871, of all the previous censuses and estimates of the population of Canada, and to learn that "it is the intention of the Dominion Bureau of Statistics, at a later date, to publish an historical volume which will contain detailed tables of all the Canadian censuses, beginning with the foundation of Port Royal in 1605 and Quebec in 1608, with a critique as to the accuracy of the various statements and estimates."

In 1871 over 80 per cent. of the population of Canada was rural, the census of 1921 showed that the rural and urban sections were practically equal, but in 1931 the urban population was 46·3 per cent. of the whole. Of rather more than local interest are pages 163 to 194 in which are tabulated with historical notes, the dates of the incorporation of urban centres in Canada, as villages, towns and cities, with the 1931 population figures. A more specific meaning is thus given to the broader figures showing the progress of urbanization, and one learns with interest that St. John's, New Brunswick, is "the oldest incorporated city in the British Empire outside of the British Isles"—a statement properly given the dignity of Clarendon type.

"The manner of growth of the white population appears to have been decidedly cyclical. Such cyclical growth conforms to certain theories on the subject. . . . Roughly the growth is related to existing density. A cycle opens with the population growing approximately geometrically, but the rate diminishes progressively from the outset. Meanwhile the absolute (arithmetic) increase increases progressively up to a point, after which it also decreases progressively until it vanishes and the population becomes stationary. . . . It is interesting to observe that the peaks of growth coincided with important points in history, viz., the American Revolution, the Irish Famine, the building of railways and the opening of the West. . . . Perhaps the most interesting period of Canada's growth is the 1821–96 period. . . . Here . . . the population passed from a high rate of increase at the beginning through various stages until it fell to 11 per cent. between 1891 and 1901, a rate indicating approach to a stationary population," (pages 103–4, and see also page 120). Between 1901 and 1911 there was "the greatest absolute increase in Canada's history," 1,835,000, and "this decade marks not so much the beginning of a new stage of growth as the preparations for this new stage" (page 121). The movement westwards was beginning, and there was a large immigration into Canada of persons with no settled outlook, and "the decade 1911–21 was spent in distributing the inflow of the previous decade, so that the increases in the two decades cannot be dissociated" (page 125). The increase in 1911–21 was 1,581,000, followed by 1,589,000 in 1921–31, "the greater part of it evidently taking place in the latter half of the decade." This study of the redistribution of population through the opening up of new areas by improved means of communication is very important, and not less so is the conclusion. "Now, an external growth as above described (*i.e.* a growth by spreading from counties of birth to other counties) is a different phenomenon from internal growth (*i.e.* indigenous growth). The former can continue only as long as new parts are opening up, and its extent depends upon whether the new parts have the same population capacity as the old. Clearly under past conditions they have not, as is shown by the fact that the newer parts become saturated sooner than the old. This is partly due to an increasing tendency to urbanization, and is consequently a matter of present-day psychology rather than of inferiority of the new parts. This psychology would probably not retard growth in the country as a whole if the towns were evenly distributed, but as a matter of fact they tend to be concentrated in the older section. It would seem, therefore, that the capacity of the whole country for growth depends upon the capacity of these towns. It would seem also that the capacity of the newer parts for urbanization will largely determine their further growth " (page 130).

Study of the growth of population involves study of fertility. but no questions on this subject were included in the census schedule, "since, through the standard registration forms now in use throughout Canada, information is already obtained as to the number of children born alive to each mother, the number now living and the number that were stillborn. In addition, the Canadian birth-forms contain detailed information concerning the parents, allowing classification under various rubrics and comparison with the corresponding census figures of population; thus the forms distinguish births to married mothers from those to unmarried mothers, and give the age, birthplace and racial origin of the mother, and, in the case of legitimate births. the age, birthplace, origin and occupation of the father" (page 39). The Administrative Report of 1934 promised that "a special study of fertility" would appear in a later volume and would deal with the actual and potential fertility of the Canadian population by races, geographical areas, occupations, density of population, etc."

Questions of family income disturb students much to-day, and they will find Tables 112*a*, 112*b*, 113*a* and 113*b* rather interesting. Households are classified according to seven rent scales and Table 112*a*, to take one example, shows us that in Canada in 1931 there were 429,708 "urban households of one family with wage-earner head (husband and wife living together in rented home)." The most numerous class was composed of 122,967 households paying from 25 to 39 dollars a month, including 560,786 persons (of whom 270,374 were children, 6828 dependents, and 35,248 lodgers), who occupied 694,581 rooms. 120,413 "heads" stated their earnings at about \$160·7 million, 3691 wives were gainfully occupied, of whom 1999 earned about \$1·3 million, and out of 50,448 children gainfully occupied 46,994 earned about \$22·9 million. One could go on for ever raising good ore from this mine. H. W. M.

5.—*Wages and Income in the United Kingdom since 1860.* By A. L. Bowley, C.B.E., Sc.D., F.B.A. Cambridge University Press, 1937. $8\frac{3}{4}'' \times 5\frac{1}{2}''$. xix + 151 pp. 8*s.* 6*d.*

"This book," says the author, "is an attempt to bring into a coherent whole the investigations that I have made on the subject of wages and income at various dates during the past forty years." How thorough and painstaking his efforts have been is shown by the fact that in the appended Bibliography of ninety-one items sixty-five are contributions by himself, including eight in which he collaborated with colleagues. Fifteen of these have appeared in our *Journal* and ten in the *Economic Journal*. It is superfluous to say how useful to the student it is to have the results of all this work brought together and summarized in brief compass. Those who are concerned with obtaining general measurements or with acquiring the main technique for handling wage problems will find all that they require in this short book, while the Bibliography will enable specialists to refer to more elaborate tables and more detailed analysis.

After a general Introduction six chapters treat successively of "the course of average wages," "real wages," "average earnings and their distribution," "earnings and needs," "the national wage-bill," and "the national income," and these are followed by six appendices—"notes on the wages censuses of the United Kingdom," "notes on separation of the factors making for changes in average wages," "notes on the table of average earnings," "notes on retail prices," "notes on the increase in middle-class occupations," and "notes on earlier estimates of national income." This close packing of material obviously prevents the making of any detailed examination, for that would occupy too much space, and to select one separate problem for analysis as an example would be equally outside the scope of this notice, which has as its purpose to draw the attention of readers to the wealth of instruction which they will find if they give close study to these pages. It is only proposed to give a few quotations illustrative of some of Professor Bowley's conclusions.

Giffen, in his paper read before this Society in 1886, summed up that "what has happened to the working classes in the last fifty years is not so much what may properly be called an improvement, as a revolution of the most remarkable description." "Would a repetition of Giffen's words give a true account for the further half-century that has elapsed since he spoke them? " asks Professor Bowley, and replies to his own question : "In a large measure the answer is Yes. Wages have increased more than have prices. The rise in the fifty years has been greatest in the classes where improvement was most needed. Hours of labour have greatly diminished: the so-called masses consume more of what Giffen termed luxuries (sugar, tea, tobacco), and have a greatly increased variety of amusements, many of them of recent invention, on which the increased margin of income over necessaries can be spent." Not only have wage-rates tended to increase, but we observe "the shifting of the relative numbers in occupations, normally towards higher or rising wages." A table is given on page 30 showing the index-numbers of wages and the cost of living and a column giving the figures resulting from the division of the first series by the second. That column is headed "Quotient," and the author explains that "it is not headed Real Wages, because of the numerous qualifications with which it must be used." This caution may be commended to other writers, and, observing it, we merely note that between 1924 and 1936 the index-number of wages rose from 194 to 197, while the cost of living index fell from 175 to 147, so that the "quotient" moved up from 111 to 134. From later pages we learn that the National Wage-Bill (including wages of shop assistants) rose from £1,600 million in 1924 to £1,720 million in 1936. "Total income fell about 5 per cent. from 1924 to 1934, while population increased about 4 per cent. Per head in 1924 the income so reckoned was £90 to £100; in 1934 £80 to £90. With the increase in prosperity since 1934 it must have approached the 1924 level per head at the time of writing" (page 89). Professor Bowley says on an earlier page that the increase in money wages between 1911 and 1924 "was partly at the expense of income from property," and the same would seem to be true of the later period.

Another interesting opinion, likely to be distasteful to hasty scribes, is that the distinction drawn between the increases of wages in so-called sheltered and unsheltered trades is "a too-hasty generalization." Another is that "it does not seem practicable to give any definite measurement of the change in the average standard of living in the circumstances of recent years" (page 39). This quotation may be linked up with another: "The standard of living may rise considerably, but only over a long period; its change is not perceptible to a growing generation, which knows that its own means are insufficient for its desires" (page 8). At the end of the chapter on "earnings and needs" Professor Bowley remarks that "the statistics for the subject-matter of this chapter are sporadic and incomplete." This is lamentable, for it means one cannot calculate with any certainty the number of families below a poverty line wherever drawn, and, unfortunately, it is only too probable that any attempt to get fuller information would meet with hostility from the catchpenny press. Lastly, students of prices will be interested in a comparison between the recorded and a computed price-index for food based on the formula $p = 0{\cdot}77\ P + 0{\cdot}23\ w$, where p and P represent retail and wholesale prices, respectively, taken as averages of their percentages in the period July 1924 to December 1929, and w is an index of wages with 1913 as base year. This equation "is closely satisfied month by month from 1924 to 1933, most closely when a lag of two months is assumed between the movement of wholesale and that of retail prices" (page 116). The correspondence of the two indices is certainly remarkable. H. W. M.

6.—*A Survey of the Social Structure of England and Wales as Illustrated by Statistics.* By A. M. Carr-Saunders and D. Caradog Jones. xviii + 235 pp. Second Edition. Oxford University Press, 1937. 10*s*. net.

It is ten years since the first edition of this book appeared, and much of the material was necessarily based on the population census of 1921. Moreover, the survey was essentially a picture of social conditions existing at the time, so that in its original form relatively little statistical comparison with earlier years was given to enable the reader to judge what progress had taken place. In this, the second, edition, the results of the 1931 census are freely used, and, in many instances, comparative figures relating to ten or more years ago are given. In addition, the text has been largely rewritten. Only the design of the book is almost unchanged, the contents having undergone entire revision.

When it first appeared, the Survey was immediately recognized as a standard work on the social affairs of the country. The second edition, by reason of more recent and comparative statistics, is to-day even more important than was the first edition ten years ago.

R. F. G.

7.—*Socialism versus Capitalism.* By A. C. Pigou, M.A. London: Macmillan, 1937. 7½″ × 5¼″. 139 pp. 4*s.* 6*d.*

On behalf of the general reader, Professor Pigou has undertaken the task of setting forth, in about 30,000 words, the relative merits of capitalism and socialism, or, to be more exact, the relative merits of a capitalist system containing certain socialized industries (*e.g.* the armed forces) and a complete nation-wide system of socialism.

Examining the two rival systems under five main heads, he takes, firstly, their capacity to remedy inequalities of income, and here he gives socialism higher marks. Which of the two is likely to provide the best allocation of productive resources or the highest technical efficiency he leaves undecided, but on the question as to which offers the best means of dealing with unemployment, the author unhesitatingly plumps for socialism. The chapter on the problem of incentive concludes with the decision that socialism should be allotted *some* more marks than its rival, but this chapter is perhaps the least convincing in the whole work. Broadly, he concludes that a system of socialist central planning offers many advantages over the existing system, subject to the proviso that it could be effectively organized. But here the difficulties are found to be so serious as to constitute an argument against change.

At the end of the examination, the examiner leaves the final decision to the reader; for, he says, it is seldom possible to show that any given course of action is "better" than another, but, making use of the incomplete data at our command, we must "take the plunge and judge." In this field, he declares, "an economist has no special qualification. . . . A wide experience of men and of affairs and a strong 'feel' for what, with the human instruments available, will or will not work, are needed here. These the present writer, like most academic persons, does not possess; and, unlike some academic persons, he is aware that he does not possess them."

But, having made this outspoken confession, Professor Pigou feels that something further is needed, and he proceeds to give us a confession of faith, while outlining the policy he would pursue if he resided at 10, Downing Street. It is a comprehensive policy, but in places a little reminiscent of a party programme. Readers may find an interesting problem in determining to which political party it could be adapted with the minimum of amendment.

For the book as a whole there can be nothing but praise. Apart from the last two pages, the author has aimed at maintaining a perfectly objective approach, although it is hardly to be expected that all his readers will think he has entirely succeeded. But none will question the value of such an attempt to throw the cold light of impartial enquiry upon a highly controversial subject, and all will admire the clarity and conciseness with which Professor Pigou has accomplished the task. C. O. G.

8.—*The Twilight of American Capitalism. An Economic Interpretation of the New Deal.* By A. S. J. Baster, Ph.D. London: P. S. King, 1937. 8½″ × 5½″. 218 pp. 9*s.*

In his preface Dr. Baster writes: "This is no attempt to provide an omnibus guide-book to all the economic aspects of the New Deal; its objective is limited to examining the consequences of the rejection of competition in industry, in agriculture, and in finance; and constructive proposals appear only by implication." This subject is enormous. To trace even superficially the ramifying consequences of the New Deal in its agricultural, industrial, and financial aspects is as difficult as to determine those parts of the Programme which rejected competition. Dr. Baster decided to treat the problem in sections. First he sketches the progress of the Depression of 1929 on: the progressive economic collapse, the discredit of business and banking leadership, the primitive relief services and the diverse advices to the President. He describes next the progress of the idea of planning, leading to the acceptance of intervention in the competitive system as it then operated, with the New Deal. In this chapter he discusses the objects of planning as he sees them, and one manifestation of planning, the Tennessee Valley Authority. Then comes intervention in finance, banking, credit, currency and Stock Exchange; intervention in industry, the N.R.A.; and intervention in agriculture. Then a description of the political background that conditioned the measures: the Constitution. Supreme Court, political system and the civil service. The concluding chapter advocates a return as far as possible to competition *à la* John Stuart Mill, on the ground that complete planning means the end of democracy, and partial planning results only in the favouring of politically powerful groups, which is in itself a threat to democracy through an access of power to secular interests, and the discredit to which the democratic system will be brought. As he puts it: " It is the central and basic contention of this book that a freely competitive economic system is the best guarantee for effective democracy that has yet been devised."

This is a sweeping thesis to rest only on the basis of evidence from the New Deal. The New Deal was formed in a desperate effort to rehabilitate the business system, and not in cold blood to replace competition, and it is on its success in the rehabilitation of business that it must be judged. The big agricultural monopolies arose, not because it was desired to make the farmers into monopolists, but because farming was bankrupt and had to be supported. The industrial monopolies in the codes were instituted because the co-operation of industry had to be secured to check the decline. The important way in which the New Deal consciously rejected competition without the object of the rehabilitation of some part of the economy was in section 7A of the N.I.R.A., which allowed labour to combine. The consequences of this very significant change Dr. Baster does not even discuss. Hence, to criticize the New Deal as an unsuccessful effort to replace competition, as Dr. Baster seems to do, is not quite fair.

The second chapter, on " Intervention and Economic Planning," is perhaps the weakest part of the book. Dr. Baster considers President Roosevelt's programme as an effort to substitute " planning " for competitive capitalism. It appears that to his mind " planners " wish to use State power to form sheltered monopolies with no considered way of replacing the automatic adjustments of the competitive system. With such emphatic criticism Dr. Baster is tilting at windmills. It cannot be denied that the results of the Administration's policy were in many cases the promotion of monopolistic prices and the favouring of special groups. In the industrial policy, at least, this was to a large extent the consequence of extreme haste and bad information. The results do not prove that planning should never be attempted, but they do prove the folly of attempting to interfere with the economic system without adequte information to act upon, and that opportunist policies such as constituted the New Deal should be avoided at all costs. This is a lesson Dr. Baster does not stress. To expect the New Deal to yield a justification of planning is useless when successful planning involves the assembly of great quantities of the most minute and accurate information, and a drafting of the plan stage by stage for a period of years with ample provision for eventualities. Dr. Baster considers planning not as a supplement to but as a substitute for the competitive system. He would admit, it seems, that certain planning of the financial and monetary system is necessary, although he does not discuss it. One side of such planning he ignores, although it has received more attention than any other type, and appears on the Statute Books in America at least since 1921—namely, planned timing of public constructional activity between prosperity and depression to flatten out the trade cycle. It is generally accepted that the competitive capitalist system as it at present exists will produce alternate boom and slump. If the Government is to intervene successfully, long-range planning is absolutely imperative, and it was this type of planning that was most persistently advocated. Yet Dr. Baster only considers the T.V.A., which, although an important and interesting experiment, was only a small part of the Public Works undertaken from 1933 on, to which the 1933–6 revival was chiefly due, and he considers it from another point of view. Accordingly he does not bring out the lack of previous planning both of works and credit facilities which prevented this part of the programme from being more effective.

With a large economic subject that is dealt with both sectionally and summarily, it is essential that there should be a clear-cut economic theory in the author's mind, otherwise the story becomes difficult to follow and loses coherence. The lack of theory is a deficiency of the book. It is not clear how the various measures discussed affected the National Income and reacted on the economy. For example, how did they affect the demand for investment goods, business confidence, and the distribution of income between groups that tended to spend, and groups that tended to save? A coherent picture does not emerge.

This book is a popular book. As an estimate of the consequences of the rejection of competition it tends, for reasons some of which are mentioned above, to be inadequate. Dr. Baster has unfortunately a florid style which detracts from the value of his remarks. There is nothing of particular interest to the statistician, as Dr. Baster makes little use of figures. Nevertheless, those who wish to learn shortly some of the mistakes the Administration made in its first term will be interested in reading it. R. W. S.

9.—*N.R.A. Economic Planning.* By Charles Frederick Roos, Ph.D. Cowles Commission for Research in Economics. Principia Press. London: Williams and Norgate. 10″ × 7″. 596 pp. *21s.*

This book is extremely satisfying to the mind. Firstly, Dr. Roos has a definite conception of the scientific attitude with which a social scientist should handle his material. Secondly, he has brilliant personal qualifications as a leading exponent of econometric theory and statistical practice, and as an economist. Thirdly, he has had unrivalled opportunities for observation of the N.R.A. in action and for the collection of material. He was principal economist and director of research in the Research and Planning Division of the N.R.A. from July 1933 to September 1934, and hence has been able to use the information both of his division and of the Cowles Commission. Finally, he has a clear-headed and vivid style of writing.

Dr. Roos fully appreciates that the N.R.A., with its profound detail and nation-wide ramifications, is too large to be dealt with satisfactorily in a single volume—and that, indeed, adequate treatment of it was beyond the powers of one person. He has therefore avoided the generalizations, on insufficient material, which are the temptations of writers on the N.R.A., and has selected a subject of tractable size, which he handles in a masterly manner. Hence the reader is left satisfied, and the ascertained realities of the case are never for a moment obscured.

Dr. Roos takes for consideration the main principles of N.R.A. policy, how the pressure of economic events modified them and their main reactions on the economy. The facts and analyses that he presents, together with his evaluation of the N.R.A., are displayed in such a way as to furnish at the end indications of what can in present circumstances be reasonably expected of economic planning of America.

"The N.R.A. in practically all its phases was characterized by a lack of definite policy and of proper understanding of objectives." The Act itself was riddled with contradictions. It proposed at one and the same time decrease of working time and increase of standard of living, dislocating economic and social reforms and economic recovery, public construction to increase demand for the investment industries and curtailment of private investment, together with the closest regulation of industrial production and prices by industry itself without the growth of monopolistic practices. Every political group had ground its axe in some way, yet Congress had none but the happiest expectations from the measure.

What the Act might have done for the nation if properly administered we shall never know, for two reasons: the first was inherent in the method of code-writing which involved the ferocious bargaining of the two parties, industry and labour, with relative strengths varying industry by industry, for the consumer's body. This arose through lack of both administrative experience and administrators, and inadequate consideration in the first place. It resulted in inequitable codes and consumer gouging, which finally converted public opinion against the Act. The second is a point of the first importance which Dr. Roos brings into its proper perspective—namely, the separation of the N.R.A. and the Public Works Administration by the President after they had been designed to work together. In the codes concessions to Labour had first to be made for fear of unionization and the President, afterwards industry had to recoup itself. It had been planned that the 3,300,000,000 dollars public works appropriation should be spent quickly to help industry while it was adjusting itself to the shortened hours and other labour reforms as well as the higher wages that were to increase purchasing power. When the N.R.A. and P.W.A. were divorced, the N.R.A. could no longer rely on public contracts to support its reforms and reinforce its authority by increasing activity. The N.R.A. was, in fact, limited "to the task of distributing through shorter hours the meagre total of existing work," and industry had to be allowed to do what it liked to the consumer in order to ensure its compliance.

The analyses of the shorter hour and minimum wage provisions are particularly fascinating. The number of points that the Administration overlooked in the hurry of events appears almost incredible to the observer. Provisions which increased labour costs were particularly unfortunate from the point of view of the durable consumer's goods industries and the capital goods industries where the ratio of labour costs was highest. These were the very industries which had suffered most and whose demand it was most necessary to revive.

It is impossible in the short space we have even to list the multiplicity of directions in which the N.R.A. took action—usually only to burn its fingers and further disrupt business confidence: Price Experiments, Fair Trade Practices, Open Prices, Cost Formulas, Wage Differentials, and so on. The conclusion is that the N.R.A., when separated from the P.W.A., reduced employment rather than increased it, while its effect on business confidence was too disastrous and far-reaching to be estimated. We are still feeling its results to-day. As regards Planning, the conclusion is that "although the United States had spent more in collecting statistics than any other country, definite answers were available to comparatively few questions: data for even the simplest forms of economic planning have been and still are lacking." Hence economic planning of the type that attempts to "fix" the various factors in the economic system were impracticable. For planning of the kind that establishes controls of a few central factors the author holds out more hope.

Apart from the economic merits, here is a vivid and exciting chronicle. Before one's astonished eyes are revealed the incredible ignorance, irresponsibility, opportunism and freshness of mind that animated the New Deal. Small character-sketches appear of the protagonists—the spell-binding personality of the President, with his terrifying mental receptivity, General Johnson, the man who was misunderstood. There is the fascinating interplay of detail: the dreadful staffing, the confused ideas of the political groups, the happy ignorance of the planners, and the inexorable responses of the massive economy to their ill-considered acts. Clearly the book had to have some limits, but one wishes that Dr. Roos had had time to criticize the principles and machinery of administration in more detail, to make more international comparisons, to go more particularly into the financial aspects, and to deal a little more fully with the reactions of the N.R.A. on other parts of the programme.

There can be few statisticians or economists who would not enjoy and profit from this book. R. W. S.

10.—*A Simple Theory of Capital, Wages and Profit or Loss.* By E. C. van Dorp, LL.D. London: P. S. King, 1937. 8¾″ × 5½″. xx + 260 pp. 12*s.*

By a "simple" theory the author, a former lecturer at the University of Utrecht, points out that he does not mean the simplicity of "the man in the street," but "that simplicity to which every scientific exertion ought to aspire," a simplicity which he says can only be attained by basing our science on the reality of economic life instead of building up huge constructions which have nothing whatever to do with real life, and expecting real life to behave in accordance with those constructions. He paints a dismal picture of a world waiting for economic science to solve its problems while rival schools of economists compete in obscurity. Finance, international trade problems and social questions must find their solution in scientific explanations of what is actually happening, or the world will go to ruin. A ray of light is then flashed across the picture. Dr. van Dorp claims that in solving the one question which originally interested him—"the interest riddle"—he found the key to all economic problems.

The general plan of the book as outlined in the preface is firstly to set out the author's own views, and secondly to criticize some of the representative theories which have dominated the world of economic thought up to the present, or which have been put forward lately. Dr. van Dorp has found it impossible, however, to keep these two objectives in water-tight compartments, and the first part of the book is so prolific with criticisms of other theories that it is difficult at times to catch a glimpse of the author's own explanation of a particular aspect of the problem, before he has passed on to his next point, and a general condemnation of the way in which it has been treated by other theories.

In common with most writers on economics, Dr. van Dorp requires his reader to master an entirely new set of definitions. Unfortunately, many of these definitions are of very slow growth. For example, on page 5 we are told that "Capital must be newly defined: it is a book-keeping concept, existing only in the mind of the capitalist, and becoming apparent when he pays wages and makes an entry in his books for the amount," but it is not until page 93 that the author produces his actual definition, although hundreds of references to capital appear on the intervening pages.

If a study of the work and theories of other writers is any qualification for writing a book on economic theory, Dr. van Dorp has the highest credentials. The second and larger part of his book is devoted mainly to criticism of the theories of Marshall, Cannan, Schumpeter, Böhm Bawerk, Strigl, Wicksell, Hayek and Keynes;

but at some time or other most of the English, German and Austrian economists come under censure—in fact in his concluding chapter the author says, "I am afraid that actual economic science as I have presented it appears rather like a chamber of horrors. . . . I am conscious that I have annihilated what distinguished men have considered as their life's work." From this massacre very little is saved; the author does admit that the wages-fund theory of Böhm Bawerk has blazed the trail for him, but he is careful to point out that Böhm Bawerk himself was not aware of the real contents of his theory and of the fact that what he had presented as one theory was actually three different and contradictory theories. In the author's own words, "It is not by its real merits . . . that Böhm Bawerk's book has had such an enormous influence. It is by its worst quality, by its utter confusion which no one was able to clear up; economic theory must now build on these merits."

The reason for devoting so much of his attention to analysing and refuting other wage and interest theories is to be found in the author's belief that if he is unable to refute another theory, he must be mistaken in his own. He certainly convinces us that other writers have provided him with very little straw, but we are not equally convinced when he says that he has been able to explain every phenomenon which up till now has resisted any attempt at explanation.

G. R. W.

11.—*Monetary Policy and Economic Stabilisation.* A Study of the Gold Standard. By Arthur D. Gayer, M.A., D.Phil. (Oxon.). Assistant Professor of Economics. Columbia University, New York. Second Edition revised. London: A. & C. Black, 1937. $8\frac{3}{4}'' \times 5\frac{1}{2}''$. xv + 288 pp. 10*s*. 6*d*.

The first edition of this book published in 1935, was reviewed in Part IV of the *Journal* for that year, and a careful re-reading only strengthens the reviewer's opinion of its high merits. The author qualified himself to write this book by his considerable experience in work connected with President Roosevelt's administration, and the esteem in which his abilities are held in the United States is shown by the fact that in 1936 he was appointed Senior Economist of the Federal Reserve Board. The question whether provision should be made in periods of prosperity for planning a public works policy designed to produce additional capital expenditure in times of recession, thus in some degree smoothing out "cyclical fluctuations," has been of late much discussed, and the object of the present note is to draw attention to the admirable summary of the argument in Chapter X of this work, where in 25 pages the chief considerations are passed under review. Reference may also be made to the author's *Public Works in Prosperity and Depression, United States, 1919–33,* for a detailed study of the problems and the manner in which the American Government handled them. Dr. Gayer holds that monetary measures are not sufficient to cure a depression, and is a strong advocate of the advance planning of public works as a means of expanding purchasing-power when it is most needed.

He does not disguise the difficulties, and, in pointing out that, while the federal government increased expenditure during the depression, local authorities heavily restricted their outlay on construction, lays his finger on one of the chief obstacles. Everyone with any knowledge of local government authorities in this country knows how futile it is to expect councillors, whose personal incomes are declining and who have the fear of their neighbour ratepayers before their eyes, to "put heavier burdens on the ratepayer" either by borrowing or by levying heavier rates. The campaign against depression must be conducted by the central government, as Dr. Gayer implies but does not expressly say. There are two ways of financing public works: they "must be undertaken either out of loans or from previously accumulated reserves, the debts in the former case being amortized at an accelerated rate during years of prosperity out of budget surpluses." There seems to the present reviewer little doubt that the former is the sounder method. "It is important," says our author, "to ensure that the additional funds injected into the market by public agencies should not be offset by a contraction thereby induced in private activity. It is equally important that they should represent new and additional money derived from expanded bank credit and not merely a diversion of resources." H. W. M.

12.—*The National Capital* and Other Statistical Studies. By Sir Josiah Stamp, G.C.B., etc. London: P. S. King, 1937. $8\frac{3}{4}'' \times 5\frac{1}{2}''$. vii + 299 pp. 10*s*. 6*d*.

Five of the eight papers included in this collection are based on papers read before this Society; these are "The National Capital, 1928 and 1935," "A New Index-Number of Profits," "Methods Used in Different Countries for Estimating National Income," "The Influence of the Price Level on the Higher Incomes," and "The Effect of Trade Fluctuations upon Profits before the War." "In most cases," says the author, "they are not reproduced as originally written, but the subjects have been brought up to date by the inclusion of statistics for the latest years available, with a great deal of new descriptive matter; some of the 'scaffolding' has been omitted, but can be found by the curious or critical in the pages of the *Journal of the Royal Statistical Society*." In the first paper, on "The National Capital," the "scaffolding," fortunately appears to be intact, some corrections have been made in the figures, and estimates for 1935 added. The estimate of the total amount of the national capital is brought up from 18,175 ± 1350 million pounds in 1928 to 21,500 ± 1800 million pounds in 1935. Very usefully the author has added an "Addendum on National Capital in Private Hands" from his article in the *Economic Journal*, September, 1918. In the second paper the chief changes (beyond bringing the index up to 1936) are some elaboration of the main graph and a restriction of the *Economist* company reports from 1909/10–1931/32 to 1931/32–1936/37. In the third paper some additional particulars are given for Greece, Poland, Bulgaria, Canada, the United States, etc., a brief criticism of "a fresh idea" started by Mr. Colin Clark, and seventeen more entries in the "authors, etc., consulted"; there seem to be no omissions of note. The fourth paper omits some tables from the original, but adds "the computed income of the 1000th person": other figures are brought up-to-date. The original paper on trade fluctuations and profits is now supplemented by "note on the subsequent history of the statistics of coal-mining profits." For appreciation and criticism of those five papers readers may be referred to the reports in the *Journal* of the discussions which followed them. They deal with topics which Sir Josiah has made peculiarly his own, and it is a great convenience to have them all in close juxtaposition; the "scaffolding" which has been removed is quite slight.

The fifth paper in this volume is a brief account from *The Economic Journal* of December, 1930, of a sample enquiry, conducted by a Committee of the British Association, into "Inheritance." Although only 56 cases of men's estates and 13 of women's estates were available, they covered a total fortune of about £3,300,000, of which rather more than one-seventh was inherited or received by gift; the example is, plainly, too small to be representative. The general reader will probably find the paper (number six) on "Alcohol as an Economic Factor" the most readable and interesting. Its remorseless destruction of popular anti-alcohol statistics is most refreshing. The examination is very detailed, and Sir Josiah's conclusion as to the effects of alcohol on efficiency is that "those who put the economic difference today at less than 7 per cent., and those who put it at more than 14 per cent., both speak against the weight of evidence." Lastly, the "Economic Distribution of the National Capital" is a reprinting from a final chapter contributed by Sir Josiah to *The British Isles* by L. D. Stamp and S. H. Beaver. Working on the Census of Production reports he groups industrial capital into four classes: mines, etc.: engineering and metals; textiles; and other manufactures, and shows that on a comparison of 1907 with the average of 1924 and 1930, the first and third of those classes have lost ground and the other two have gained. Other estimates of his own for "forty-five years ago," "pre-war," and for 1928 are added.

H. W. M.

13.—*The Balance Sheets of Imperialism.* By Grover Clark. New York: Columbia University Press. London: Oxford University Press, 1936. Reprinted 1938. 11¼″ × 8¾″. xii + 136 pp. 14s.

There has been much discussion in recent times concerning the economic as distinct from the political importance and value of colonies. They are, it has been claimed, important outlets for population, they provide invaluable opportunities for money-making commerce, and, finally, they permit a control of raw materials at all times advantageous, but in wartime essential for national safety.

Such claims have been subjected to many attacks, but to few more devastating than that of Mr. Clark in this overwhelmingly statistical book, about five-sixths of which consists of tables showing changes in population, migration, trade, world production of raw materials, and other relevant material.

He considers that up to the end of the eighteenth century, the ledger of imperialism would probably show a cash profit to the Western governments and peoples if the value of lives lost were excluded, while from 1800 to 1880, the expenditure incurred by the governments was maybe roughly counterbalanced by the gains accruing to their citizens. He has, however, no hesitation in declaring that since 1880, the expenditure incurred by the modern colonizing States has far outweighed the possible cash profits of the trade with them, while any possible gains in other than direct money terms would be quite insufficient to wipe out the debit balance.

His opinions concerning the balance sheets of Imperialism in the first two periods are put forward with little or no supporting evidence. In those earlier days, economic and other conditions differed considerably from those obtaining to-day, while the relevant statistical data, if not entirely non-existent, are scarce and less reliable, so the author has with good reason directed his attention almost solely to the last fifty years. Here he has not spared himself. One might perhaps have doubts regarding one or two of his minor assumptions, but these are of little significance, and Mr. Clark marshals his voluminous evidence so convincingly as to leave little doubt that his case has been amply proved. C. O. G.

14.—*Unit Trusts and How they Work.* By C. L. Rosenheim, M.A., and C. O. Merriman, A.C.A., with a preface by W. Piercy, C.B.E. London: Pitman, 1937. 8½″ × 5¼″. xiii + 87 pp. *7s. 6d.*

While the oldest investment trust dates back to 1863, unit trusts have only come into being during the past six years, in which period they have accumulated about £80 million of invested funds. This book describes the services they perform, how they work, their development from fixed to flexible trusts, and gives in the appendix a summary of the interim report of the Stock Exchange subcommittee on Fixed Trusts and an abridgment of the report of the departmental committee appointed by the Board of Trade.

These unit trusts appeal mainly to the small investor, and enable him to purchase with a small sum a wide range of investments, thus spreading his risk. At the start of a trust a purchase is made of a unit of several thousand pounds of investment comprising securities in different undertakings. The purchase having been made, the trust discloses its list of investments and creates sub-units valued often at about £1. These sub-units are then offered to the public at a price which is arrived at by re-valuing the investments at the market price of the day on which the sub-units are taken up by the public. After a time it was realized that the original unit trusts were too rigid, and flexible trusts then came into existence in which power was taken by the managers to change the investments within certain defined limits.

This book, intended primarily for accountants and stockbrokers, will appeal also to members of the general public who are interested in the movement. It is a clear, concise, and conscientious piece of work, admirably carrying out the purpose for which it is intended. It is written by two practical men, both of whom are engaged in

Stock Exchange business, and has a preface by Mr. W. Piercy, who is a stockbroker and a former lecturer at the London School of Economics. B. E.

15.—*Other New Publications* *

Cotta (*Freppel*). Economic Planning in Corporative Portugal. With a Preface by Dr. Marcello Caetano. London: P. S. King, 1937. $8\frac{1}{2}'' \times 5\frac{1}{4}''$. xiv + 188 pp. 8*s*. 6*d*.

[Portugal offers the unique spectacle of an economic system planned by a professor of economics and carried out under his supervision. Dr. Salazar, justly characterized as a "retiring, silent, non-violent dictator," occupied the Chair of Economics and Finance at the University of Coimbra when, in 1928, he was prevailed upon to take office as Minister of Finance. In that capacity and since, as Prime Minister, he has been gradually eliminating the disorder and poverty which, though of long standing, had increased since the setting up of the Republic owing to the incapacity and conflicting interests of those in power. Public finance was first set in order, with the result of converting the formerly perennial budget deficits into a gradually improving surplus; production and industry were next planned, the State, through its appointed organs, assuming control over production, prices, and the means of securing a fairer distribution of wealth. Private enterprise is specifically recognized as "the most prolific instrument of progress," with industrial co-operation as the means of harmonizing it in a planned system; although the co-operation was enforced to begin with, it is not intended that the trade organs shall eventually be subjected to more State control than is regarded in democratic countries as desirable for public utility undertakings. The book briefly surveys the former state of affairs in Portugal, describes the financial stabilization in some detail, and sets out the basic principles of the "planned economy" with the organs and methods of working. A chapter is given to each of the principal industries: wheat, wine, fruits, rice, fish, agriculture, forest products, manufactures; there follow accounts of insurance and banking services, and the results of the reforms under each head are shown in figures. The last chapter reviews the "corporative control effected in Portugal . . . in the light of economic doctrine," and especially points out its concordance with the views expressed by Professor Pigou in his *Economics in Practice*. The matter of the book is, in short, of considerable interest; unfortunately, however, there is no index, and the writing, with the exception of the preface by Dr. Caetano, abounds in errors of grammar and bad phrasing. The fact that a book is primarily instructive and not literary cannot excuse such phraseology as "it gave its report in December of that year, same having been published in February next," "in proportion of," or such words as "suppletory" and "peripherical."]

The Story of the General Register Office and its Origins from 1538 to 1937. Compiled by the Registrar General and illustrated by certain exhibits shown at the General Register Office, Somerset House, Strand, W.C.2, in commemoration of the centenary 1837–1937 of the General Register Office, and Registration Service in England and Wales. $9\frac{1}{2}'' \times 6''$. 30 pp. London: H.M.S.O., 1937. 6*d*.

[This is the history in brief of registration through four centuries: the non-parochial registers of the Foreign Protestant Churches and the Chapels Royal; the institution in 1538 of parochial registration by the Established Church; the increase in number and importance of bodies outside the scope of the parochial system and the consequent decrease in its effectiveness; the passing of the Registration Act and Marriage Act of 1836. The evolution of the marriage law is described, with some amusing records of marriages in the early eighteenth century. We are told of the "marriage shops" ("Sir, will you please walk in and be married?") and of Ashwell, the Fleet marriage clergyman, whose annotations to the entries in his registers make entertaining reading and throw much light on the marriage customs of those days. An account is given of the preliminary history and ultimate passing of the Census Bill of 1800, and of the development of the census system. The origin of the present home of the General Register Office is traced back to 1539, when Henry VIII granted to the Earl of Hertford, later the Protector Somerset, "Chester Place outside Temple Bar," on which site was built the Protector's palace; and a brief account is given of this palace under various ownerships, its demolition, and the construction of the present Somerset House.]

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* *See also* ADDITIONS TO LIBRARY, p. 498.

Kuczynski (*R. R.*). Colonial Population. Published under the auspices of the Royal Institute of International Affairs. Oxford University Press. London: H. Milford, 1937. $8\frac{1}{2}'' \times 5\frac{1}{4}''$. xiv + 97 pp. 5*s*.

[The author discusses the methods, and the want of method, of census registration and birth and death recording in colonial countries, showing why the figures are in many instances untrustworthy and why they can seldom be used for purposes of comparison. He gives the published figures, taken from official returns, including those of the League of Nations, of the populations of colonial and mandated areas—total numbers and racial and natal categories—with notes on the various methods and classification employed and a chapter explaining where compulsory birth and death registration is and is not in force. This portion of the book (four chapters) with the introduction occupy 36 + 44 pages; the rest (53 pages) consists of notes and tables showing the sources of the various figures, with explanatory comment. There is a useful index of the place-names, with all page references to each. The publisher's note says that the book will be of great value as a work of reference; we should, however, rather describe it as an annotation to works of reference.]

Sarkar (*Benoy Kumar*). Social Insurance, Legislation and Statistics. A Study in the Labour Economics and Business Organisation of Neo-Capitalism. Calcutta Publishers, 1936. $8\frac{3}{4}'' \times 5\frac{1}{2}''$. xxii + 446 pp. *Rs.* 8.

[The experiences of Germany, Great Britain, and France have formed the basis of this investigation, Germany being the pioneer of sickness, accident and invalidity insurance, and Great Britain of unemployment insurance. The author has not, however, confined his study to these three countries; he has investigated social insurance in Italy, Japan, Czechoslovakia, Russia, and the United States. The book has been written "with an eye to India's economic development, social progress, and national efficiency." The first chapter deals with the various branches and systems of social insurance, the second with the "socio-economic structure of the labour-world" (including sections on social insurance as a labour phenomenon, industrial workers in India and abroad, earnings of Indian workers, the politics and shortcomings of Indian trade unions, Labour-India and world economy, and the welfare and "nation-building" functions of clerks). The next four chapters are concerned with the four main branches of social insurance: sickness and maternity; accident and occupational disease; invalidity and old age; unemployment; and the subject of the last chapter is "Social insurance as an expression of neo-capitalism." Nine charts are included: for India, birth and death rates, 1901–32, and workmen's compensation, 1925–32; for Britain, poor relief, 1914–33, unemployment, 1922–33, and State aid in health insurance, 1914–32; for Italy, industrial accident insurance, 1919–27, and invalidity insurance, 1921–30: for Germany, sickness insurance, and comparisons between accident, sickness, and invalidity insurance, 1885–1930. There is an index.]

Shukla (*J. B.*). Life and Labour in a Gujarat Taluka. London, New York, and Toronto: Longmans, 1937. 8½″ × 5½″. xiv + 291 pp. 9*s*.

[In taking a taluka, a sub-division of a district, as the field of study for an enquiry of this kind the author is departing from customary methods, which are either to study intensively a typical village of a particular large area or to study the large area (usually a province or sub-province) in a more general way. For the purposes of this work the taluka is divided into five groups, based on certain economic factors, one typical village and one or two with special peculiarities being selected from each group. 40–50 per cent. of the families (representative of caste and class) were selected from each village and, in addition, families with special peculiarities were selected from each of the "special" villages. Village records and those of Government departments were consulted, and as the work was carried out at the same time as the 1931 census, the co-operation of the Census Office was obtained. As would be expected in such a study, the geographical and physical features of the taluka are described, population is discussed in some detail, figures being given of growth, migration, sex, age, and caste distributions, civil condition, occupations, etc., and chapters are included on the land and its problems, agricultural labour, capital, and wealth, and transport and marketing. Other chapters deal with agrarian indebtedness (out of a house-to-house enquiry of 793 families, 603 were in debt), the growth of the co-operative credit movement, rural problems, and rural reconstruction. Existing ills in the present economic system are brought to light and discussed, and remedies are suggested. The schedule used in the family enquiry and the questionnaire submitted to the leading agriculturists are given in appendices.]

Tingsten (*Herbert*). Political Behaviour: studies in election statistics. London: P. S. King, 1937. 8½″ × 5¼″. 231 pp. 9*s*.

[In the five chapters of this book, the author, who is Professor of Political Science at the University of Stockholm, endeavours to throw light on the comparative electoral behaviour of the sexes, of age-groups, and of different social classes, and on the effects of compulsory voting, with some notes on special aspects and problems of popular voting. The material available for study is far from complete or satisfactory, since only a few countries classify in any way the votes cast and fewer still offer mutually comparable records. Some broad conclusions, however, appear to be justified. The experience of countries where the sex of the voter is recorded shows that women undoubtedly exercise their rights less often than men, the difference in recent years averaging about 10 per cent.; and there is some evidence that the women's vote tends to be of a conservative and "bourgeois" nature, probably owing to certain facts which emerge from the figures obtained—namely, that the voting frequency rises with social status and that this is especially true of women's voting. The age-group statistics obtained indicate that electoral participation is low in the youngest groups, rises gradually to a maximum between the ages of 40–50, and then steadily declines. The special aspects briefly touched on in the final chapter include voting frequency in referendums as compared with elections and in the country as compared with towns, reasons for abstention from voting and some electoral participation in different countries and at different times.]

STATISTICAL NOTES

(1) British Official Statistics

On page 480 we give our usual table summarizing the *oversea trade* of the United Kingdom for the years ended February 1937 and 1938. During 1937 there was a rapid increase in the excess of imports over exports of merchandise, averaging over £7 million a month. This increase is still continuing, the total increase for the first two months of the year being £14 million. The increase in the excess of imports over exports from £57·6 million to £71·6 million resulted from a rise of about £15 million in retained imports and £1 million in exports of United Kingdom goods. It seems unlikely that there was any very substantial change in the quantity of goods exported, but a decline rather than an increase is indicated, and compared with the position as it was in the middle of last year, there has been a definite recession. The increase in imports was due in part to higher prices, but as prices were rising in the early part of last year and have fallen unevenly in recent months, it is difficult to estimate the precise influence of this factor. Of the total increase of £15 million in retained imports, over one-third was in the iron and steel groups, including iron ore.

Total *imports* during January and February 1938 were valued at £160,657,000 as compared with £147,331,000 a year earlier. Re-exports, on the other hand, declined in value from £12,030,000 to £10,323,000, mainly as a result of smaller re-exports of hides and skins, wool and rubber, both in quantity and value. The decline in re-exports would have been even more substantial had the Soviet Union not increased their purchases of non-ferrous metals from £395,000 to £1,605,000. Re-exports of nickel were £1 million more than in the first two months of last year.

The value of retained imports of food, drink and tobacco amounted to £67,422,000, being £6,548,000 more than a year earlier. The principal increase was about £3 million (32 per cent.) in respect of dairy produce—butter, cheese and eggs all being imported in larger quantity at much higher prices. The value of the retained imports of tobacco rose by about £2 million, nearly 100 per cent., the quantity imported a year ago being abnormally small. Barley was the only one of the important cereals imports of which were greater than a year earlier, but prices were considerably higher in each case, and there was a relatively small decline in the aggregate value of the grain and flour imported. Retained imports of meat rose in value by

£1,285,000 (10 per cent.), essentially as a result of higher prices, no important change in the quantities imported being recorded. Imports of cocoa were only half those in January–February 1937, and the value fell from £2,006,000 to £544,000. Tea, on the other hand, was imported in substantially greater quantity at higher prices.

From the above it will be seen that the rise in prices of foodstuffs was very general—for raw materials, on the other hand, average values were in most cases lower than a year ago. Retained imports of raw materials in the two months rose by £3,143,000 to £43,254,000, mainly as a result of the decline in re-exports. There was a rise from £1·1 million to £3·5 million for iron ore and scrap ; rubber rose by £2·3 million and paper-making materials by £1·4 million. Retained imports of wool declined by £2·2 million and of cotton by £1·7 million, the last-mentioned decline being wholly due to price changes.

An increase from £33,658,000 to £38,642,000 was recorded for retained imports of articles wholly or mainly manufactured. Imports of iron and steel were more than three times as great in both quantity and value as a year ago, the increase in value being £3·4 million. A heavy increase of £2·2 million was recorded for refined petroleum, there being a rise in both quantity and average value, and a decline of £1·1 million for non-ferrous metals, owing to the larger re-exports already mentioned.

Exports of United Kingdom goods during the first two months of this year were valued at £78,714,000, being £1,058,000 more than a year earlier. For food, drink and tobacco there was a decline of £299,000, and for raw materials one of £1,070,000, all the groups in this class except coal showing declines. The principal reduction was £1,168,000 in respect of raw and waste wool and woollen rags, due to the smaller quantities exported. Exports of coal increased in value by £919.000 (19 per cent.), but there was no increase in the quantity exported. The principal changes were increases of 259,000 tons and 143.000 tons in exports to Italy and Spain and a reduction from 1,637,000 tons to 1,150,000 tons in exports to France. Exports of manufactured goods rose by £2,697,000 to £62,302,000. The principal increase was £2,363,000 in exports of machinery, but for both iron and steel and vehicles increases of about £900,000 were recorded. Apart from silk yarns and manufactures, there was a general decline among the textile groups, that for cotton yarns and manufactures amounting to £1,432,000.

The increase in value of the exports of iron and steel was due wholly to higher prices, the quantity exported declining by 68,000 tons (16 per cent.). The decline was mainly in black sheets, galvanized sheets and wrought tubes. Exports of machinery rose by

16,200 tons (27 per cent.), one third of the increase being in respect of textile machinery. In the vehicles group larger exports of aircraft and ships were recorded. For motor vehicles there were no significant changes in quantity, but the value increased, and the aggregate exports of locomotives and other rolling-stock were likewise about the same as a year ago.

Exports of cotton piece-goods continued to decline, there being a very substantial fall of 65 million square yards (20 per cent.) compared with the first two months of last year. This was due mainly to reduced exports to British West Africa and India. There were smaller exports of cotton yarns and thread, and the decline in the wool group was also general. The reduction in exports was likewise very general among the other textiles, the decline for linen piece-goods being particularly marked.

Imports of *bullion and specie* during January and February amounted to £38·1 million and exports to £17·1 million, the import excess of £21 million comparing with one of £17½ million a year earlier. Of this import excess £5·3 million was in respect of silver, following a total of £10·5 million in 1937, there being continued abnormal imports from Hong Kong (doubtless arising from the hostilities in China) and exports to the United States.

Wholesale prices showed little general change in January 1938 as compared with December 1937, a slight increase in food prices being practically balanced by a decline in those for industrial materials and manufactures. In February, however, the fairly steady and continuous fall in the latter group since July 1937 reasserted itself and the Board of Trade general index number of wholesale prices (1930 = 100) fell from 107·6 in December 1937 to 105·8 in February. The number is now only 1·8 per cent. above that for February 1937, and is rather more than 5 per cent. below the highest point reached in July 1937. Apart from food prices the only groups showing an advance in February 1938 as compared with a year earlier were those for coal and iron and steel. Coal prices advanced 10·5 per cent. and iron and steel 24·6 per cent. Iron and steel prices have shown a practically continuous advance since the middle of 1932, but the advance was very gradual during 1934–6, and more than half of the advance (28 per cent. out of 55 per cent.) took place during last year. The most considerable declines in price were in the non-ferrous metals (22·5 per cent.) and in cotton (12·2 per cent) wool (19·0 per cent.) and other textiles (7·6 per cent.). The fall in non-ferrous metal group represents chiefly the reaction from the strong

Movements and Classes	Twelve Months ended February, 1937	Twelve Months ended February, 1938	Increase (+) or Decrease (−)
Imports, c.i.f.—	£'000	£'000	£'000
Food, drink and tobacco	385,603	439,061	(+) 53,458
Raw materials and articles mainly unmanufactured	254,483	315,721	(+) 61,238
Articles wholly or mainly manufactured	217,209	280,877	(+) 63,668
Other articles	5,657	6,731	(+) 1,074
Total Imports ...	862,952	1,042,390	(+) 179,438
Exports, f.o.b.—			
United Kingdom Produce and Manufactures—			
Food, drink and tobacco	36,436	38,481	(+) 2,045
Raw materials and articles mainly unmanufactured	53,075	63,582	(+) 10,507
Articles wholly or mainly manufactured	346,192	407,536	(+) 61,344
Other articles	12,994	13,053	(+) 59
Imported Merchandise—			
Food, drink and tobacco	11,645	13,322	(+) 1,677
Raw materials and articles mainly unmanufactured	34,839	34,147	(−) 692
Articles wholly or mainly manufactured	16,015	25,352	(+) 9,337
Other articles	332	638	(+) 306
Total Exports ...	511,528	596,111	(+) 84,583
Bullion and Specie			
Imports	355,664	298,521	(−) 57,143
Exports	129,555	205,082	(−) 75,527

Movements of Shipping in the Foreign Trade	Number of Vessels	Thousand Tons Net	Number of Vessels	Thousand Tons Net	Number of Vessels	Thousand Tons Net
Entered with cargoes—						
British	24,238	37.868	25,100	39,605	(+) 862	(+)1,737
Foreign	26,139	29,538	28,436	31,313	(+)2,297	(+)1.775
Total entered ...	50,377	67,406	53,536	70,918	(+)3,159	(+)3,512
Cleared with cargoes—						
British	29,291	34,223	30,890	35,881	(+)1,599	(+)1,658
Foreign	21,159	22,776	23,579	25,318	(+)2,420	(+)2,542
Total cleared ...	50,450	56,999	54,469	61,199	(+)4,019	(+)4,200

outbreak of speculative buying in these metals that took place in the first three months of 1937. The fall in textile prices is unfortunately reflected in the increased unemployment in the textile industries, the percentage unemployed of insured workers in those trades having risen from 10·3 in February 1937 to 20·9 in February 1938. Basic materials as a group fell in price as much as 6·3 per cent. during the first two months of 1938, and prices are 17 per cent. lower than twelve months ago. Prices of the intermediate products, manufactured articles and building materials are, however, still appreciably higher than at the beginning of 1937. Among the most noticeable decreases in prices during the twelve months ended February 1938 were those for rubber, which fell over 33 per cent., and for hides and skins, which fell from 20 to 40 per cent. in certain instances.

The Board of Trade index numbers of wholesale prices for the latest three months are given below :—

Averages for the year 1930 = 100

Date	Total Food	Total not Food	All Articles	Basic Materials	Intermediate Products	Manufactured Articles	Building Materials
Dec. 1937	104·4	109·2	107·6	106·9	107·7	114·1	105·0
Jan. 1938	105·0	109·0	107·7	105·8	108·0	114·0	105·1
Feb. „	103·4	106·9	105·8	100·2	106·4	113·4	104·7
Feb. 1937	*98·6*	*106·5*	*103·9*	*120·9*	*104·3*	*103·2*	*101·2*
„ 1936	*88·1*	*93·6*	*91·7*	*96·3*	*90·1*	*96·1*	*94·9*

The figures for certain of the other British index numbers of wholesale prices and the official index numbers for Germany, France and the United States are given below for comparison.

Date	Board of Trade (1930 = 100)	*Economist* (1927 = 100)	*Statist* (1913 = 100)	*The Times* (1913 = 100)	France (*Stat. Générale*) (July 1914 = 100)	Germany (*Stat. Reichsamt.*) (1913 = 100)	United States (Bureau of Labour) (1926 = 100)
Dec. 1937	107·6	77·2	114·5	123·9	601	105·5	81·6
Jan. 1938	107·7	76·5	113·5	121·6	612	105·6	80·8
Feb. „	105·8	75·6	113·4	119·8	614	105·7	79·7

It will be seen that France is the only country in which an appreciable increase in prices is shown, due no doubt to the unsteadiness of the franc.

There was a reduction of nearly 2 per cent. in the general level of retail prices during January and February 1938, due entirely to the seasonal fall in the prices of certain articles of food, viz. eggs, cheese and milk. The general index number of the Ministry of Labour for retail prices of articles of working-class consumption fell from 159 to 156 (prices at July 1914 = 100) and the index number for articles of food fell from 145 to 140. Prices, however, are still appreciably above those for the corresponding period of 1937, when the general index number stood at 151 and the food index number at 135. The Ministry of Labour's index numbers for recent months are given below, the prices at July 1914 being taken as 100.

	Dec. 1st, 1937	Jan. 1st, 1938	Feb. 1st, 1938	Mar. 1st, 1938	Mar. 1st, 1937	Mar. 1st, 1936
Food Prices	146	145	142	140	135	129
All Items (food, clothing, fuel, rents, etc.) ...	160	159	157	156	151	146
All items (a year earlier) ...	151	151	151	151	146	141

There was a slight reaction in February 1938 from the increase in *unemployment*, which had been continuous since September 1937, and the percentage unemployed in the insured trades in Great Britain and Northern Ireland declined from 13·3 to 13·2. The percentage unemployed at the end of 1937 had risen to 12·2 and the increase of 1·1 per cent. in January 1938 was only in keeping with the usual slackness in employment at the beginning of the year, and could not be considered excessive. The usual recovery in February was disappointingly small, amounting to no more than about 10,000 less unemployed in the insured trades. Since the two years of bad employment (1930 and 1931), the reduction in the numbers unemployed between January and February was greater in each of the years 1932–7 than in 1938. It is possible, however, that the taking of the register a week earlier than usual on account of the Ministry's revised method of recording may have had some slight adverse affect on the figures, but the outlook for any considerable improvement in employment is not at all encouraging. The percentage unemployed in February 1937 was 11·6* compared with 13·2 per cent. in February 1938.

Unemployment was highest in Northern Ireland (29·5 per cent.) in February 1938 and lowest in London (8·6 per cent.). It was as high as 23·8 per cent. in Wales and between 17 and 18 per cent. in the North-Western, Northern and Scotland Divisions. In the South-Eastern, South-Western and Midlands Divisions of England the proportion unemployed was between 9 and 10 per cent. In the North-Eastern Division it was 133 per cent.

Compared with twelve months earlier employment was worse in February 1938 in practically all industries excepting mining, pig-iron manufacture, shipbuilding and marine engineering, bread, etc., making and grain milling, public-works contracting, and in national and local government and public utility services. The falling off was greatest in the tinplate industry and in the textile trades generally, especially in the cotton, woollen, carpet and linen industries. The average rate of unemployment in the textile trades in February 1938 was as high as 20·9 per cent., and apart from these the only trades recording an unemployment greater than 20 per cent. were public works contracting 39·3 per cent., fishing 33·3 per cent., tinplate 35·2 per cent. and dock labour 30·9 per cent.

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* Revised figure.

The proportion unemployed among insured persons employed in *agriculture* was 8·4 per cent. in February 1938, compared with 9·0 per cent in January and 8·3 per cent. in December 1937. In February 1937 the proportion was 4·8 per cent. Of the 690,000 persons insured under the agricultural scheme only 38,900 are females, but their rate of unemployment was as high as 37·2 per cent. in February, compared with 6·7 per cent. of males unemployed.

The number of workpeople aged 14 to 64 (insured and uninsured) on the registers of the employment offices of the Ministry of Labour in Great Britain are given below for the latest three months.

Date	Wholly Unemployed	Temporarily Stopped	Persons normally in Casual Employment	Total
Dec. 13th, 1937 ...	1,283,604	324,779	57,024	1,665,407
Jan. 17th, 1938 ...	1,418,695	324,134	63,778	1,827,607
Feb. 14th, „ ...	1,404,912	335,084	70,425	1,810,421
Feb. 22nd, 1937 * ...	*1,349,912*	*152,084*	*70,425*	*1,572,421*
„ *24th, 1936* ...	*1,677,077*	*259,292*	*88,652*	*2,025,021*

* The figures for this date have been revised.

(2) OTHER STATISTICS

Stock Exchange Securities.—As measured by the index number of the Bankers' Magazine there was an improvement of nearly 1 per cent. in the values of Fixed Interest Stocks during January and February 1938, but this was almost entirely due to the appreciation in British and Indian Funds, although United Kingdom Corporation stocks showed some slight advance in price. On the other hand, Foreign Government Stocks fell away to the extent of 6 per cent. and British Railway Preference Stocks and Debentures also declined over the period. As regards Variable Dividend Securities, although there was some resistance to a decline during the earlier part of the period in certain classes of shares, the net fall during the two months amounted to 3·4 per cent. British Railway ordinary stocks and United States and Foreign Railway shares were considerably lower, and oil and rubber shares declined appreciably. Iron, steel and coal shares fell away as much as 10 per cent. and their market value is now much below that obtaining in the early months of 1937. The general index number for all classes of securities which was 133·1 in December 1936 and 121·2 in December 1937 was 120·7 in February 1938. This last figure was calculated before the Cabinet changes in Great Britain, and before the annexation of Austria to the German Reich.

The decline in *tramp shipping freights*, which commenced about October 1937 and continued until the end of the year, persisted during January and February 1938, showing a fall of rather more than 8 per cent. in February as compared with December 1937 and of nearly 36 per cent. compared with September 1937, when freights were higher than in any month since the autumn of 1926. According to the new index number of the Chamber of Shipping * (1935 = 100), freights fell from 201·7 in September to 141·0 in December 1937, and to 138·2 and 129·5 in January and February 1938 respectively. Compared with February 1937 there was a decline of 18 per cent. Feights declined for most voyages as compared with a year ago and for nearly all cargoes, but the agreed minimum rates were maintained in those trades where such schemes operate. There are reports of vessels being laid up from time to time, and it does not appear probable that freights are likely, for some time at any rate, to approach the high levels obtained during 1937.

The Statistics of *retail sales* prepared by the Bank of England in conjuction with various retail distributors' associations and co-operative societies are now complete for the trade year February 1937 to January 1938, and show an increase of 7·6 per cent. compared with the previous twelve months. Sales of articles of food increased by 9·2 per cent. in value and of other articles by 5·8 per cent. No doubt the advance in retail food prices over the period accounted for a considerable portion of the increased sales. (Over the year 1937 the retail food prices index number of the Ministry of Labour averaged 139 as compared with 130 in 1936, or an advance of 6·9 per cent. and the Board of Trade index number of wholesale prices of articles of food indicated an advance of 5·1 per cent.) For January 1938 total sales were 6·2 per cent. more than in 1937 and the index number for average daily sales (1933 = 100) was 127, or higher than in any January since the statistics were collected.

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* A full account of this new index number was given by Dr. Isserlis in Part I of the *Journal* 1938, pp. 53–146.

CURRENT NOTES

Many Fellows of the Society will remember the discussions in the Society which turned on the use of the multiplier to estimate National Capital, and in these the names of Sir Bernard Mallet, Mr. Strutt, Sir Timothy Coghlan, and Sir Josiah Stamp, were especially prominent. Largely as a result of these discussions, the Board of Inland Revenue published for 1911 to 1915 details of the age of persons leaving estates over £100 in England and Wales, and they were used by Sir Bernard Mallet and Mr. Strutt in their paper before the Society in 1915 on "The Multiplier and Capital Wealth." The collection of the estate-duty figures by age was suspended during the War, but when the Statistical Department of the Board of Inland Revenue was re-established, the figures were again published, and this time in an improved form, giving details by sex as well as age. The publication of the figures was continued until 1930, but was then stopped. This was a matter of regret, since the information was essential for estimating the personal distribution of capital in the country, and the figures had been found to be of value to all interested in economics and sociology. Renewed interest in these figures and in their collection was stimulated by a paper read before the Manchester Statistical Society on "The Distribution of National Capital," and it was decided by the Manchester Statistical Society and the Royal Statistical Society jointly to approach the Board of Inland Revenue to see whether the time was opportune for the resumption of the publication in the old form of the figures relating to estates passing at death each year. The Council are glad to be able to announce that the Board have acceded to their request, and the Eightieth Report of the Commissioners just published for the year ended March 31st, 1937, gives the details for 1936. 131,895 estates valued at £528 million passing at the death of their owners in England and Wales in 1936–37 are analysed according to size of estates, and age and sex of persons leaving estates. The Commissioners hope to be able to publish similar details at regular intervals in the future.

This Society has always been alive to the need for obtaining more adequate information about the economic and social life of the country and in this search the Society has always received the ready co-operation of Government Departments. On this occasion—and not for the first time—we have to thank the Commissioners of the Board of Inland Revenue on behalf of all students of finance.

We have received a copy of a "Bibliography of the Collection of Books and Tracts on Commerce, Currency, and Poor Law (1557 to 1763) formed by Joseph Massie (died 1784)," transcribed from *Landsdoun Manuscript mxlix* with Historical and Bibliographical Introduction by William A. Shaw, Litt.D. Joseph Massie was an active pamphleteer in support of Pitt, and Dr. Shaw decides "that his mind was one of extraordinary originality and acuteness, but that his outlook was mainly political and polemical. . . . During the Seven Years' War, when all his faculties were absorbed in the support of Pitt's policy, he developed a remarkable gift for abstract economic analysis, he showed a complete mastery of statistics and trade history and evinced an extraordinary originality." First of all Dr. Shaw gives a list of twenty-three books, pamphlets, and letters written by Massie, with a synopsis of each, and then a list of 4,411 tracts, etc., collected by him. This last list is a valuable and interesting indication of the economic material available during the period covered and also of the assiduity of a well-known pamphleteer.

Corrigenda in the Annals of the Royal Statistical Society.

Page 159, lines 19–20. For "*Frean*" read "Fream"; for "*Goodwin*" read "Goodsir"; for "*Barford-Sarrat*" read "Barfoot-Saunt".

Pages 160–1. *The Guy Medals.* Mr. R. H. Hooker, who was Assistant Secretary 1891–1895, points out that the whole scheme was the work of Dr. Mouat, who personally drew up the first regulations. Dr. Mouat, as President, took the chair at the Council Meeting on May 21st, 1891, and a Memorandum by him on the Society's Medals is included in the Minutes. The adoption of the scheme for the Guy Medals was proposed and seconded by Sir R. W. Rawson and Mr. T. H. Elliott, and the Rules governing Awards are printed in the *Journal*, Vol. 55, pages 296–7. The statement on page 161 of the *Annals* that a bronze medal was subsequently added is incorrect, for a bronze medal was part of the original scheme though no award was made till 1936.

Page 173. Mr. Hooker also points out that the statement that his paper of 1905 was the first mathematical paper after the Jubilee Volume is an error, for Mr. Yule's paper on the "History of Pauperism treated by Frequency Curves" appeared in 1896. We may add that that paper was followed by an article by Mr. Yule on the " Theory of Correlation " in 1897, and by another paper on " Causes of Changes in Pauperism " in 1899. Papers and articles by Edgeworth also appeared in the Journals for 1888, 1889, 1890, 1893, 1894, 1895, 1896, 1897, 1898, 1899, and 1900, notably " Some New Methods of Measuring Variation in General Prices" (1888), " Miscellaneous Applications of the Calculus of Probabilities " (1897–8), and " The Representation of Statistics by Mathematical Formulæ " (1898–9).

Page 213. The *Journal* reference for the paper by B. and H. Ellinger on " Japanese Competition in the Cotton Trade " should be " 1930, II ", *not* " 1929, II ".

Substitute " Dinner Club " for " Dining Club " on pages 69, 110, 152, 161, 189, 230, 231 and 233.

Under the auspices of the Edinburgh Mathematical Society, a Mathematical Colloquium will be held in St. Andrews, Scotland, from July 4th to 15th, 1938. This year is the three-hundredth anniversary of the birth of James Gregory, who held in succession the Chairs of Mathematics in St. Andrews and Edinburgh Universities, and the occasion will be celebrated in connection with the Colloquium as follows :—

The Royal Society of Edinburgh will hold a commemoration of James Gregory in their Rooms at 22 George Street, Edinburgh, on the afternoon of Monday, July 4th. This will be regarded as the opening meeting of the Colloquium. The University of St. Andrews will hold a Graduation at which Honorary Degrees will be presented to a number of eminent mathematicians. This will take place on Tuesday, July 5th, and will be followed by an evening reception.

Professor H. W. Turnbull, F.R.S., Regius Professor of Mathematics in the University of St. Andrews, will lecture during the Colloquium on Recent Discoveries in the History of Seventeenth-century Mathematics, making special reference to the life and work of Gregory.

The following Courses and Lectures have been arranged for the Colloquium :

A.—Invariant Matrices and Symmetric Group, by A. C. Aitken, F.R.S. B.—Analytic Deformations and Auto-equivalent Functions, by G. D. Birkhoff, Professor of Mathematics in Harvard University. C.—The Interactions between the Elementary Particles of the Universe, by E. Whittaker, F.R.S.

D.—Aspects of Mathematical Biology, (1) by W. O. Kermack, D.Sc., LLD., (2) by I. M. H. Etherington, B.A., Ph.D.

In addition, single lectures will be arranged, also informal talks and discussions on the lecture courses.

By the courtesy of the St. Andrews University Court the Colloquium will be held in the University Hall. Members of the Colloquium (and their relations or friends) may stay at the Hall, which has been reserved entirely for this purpose. Applications should be made as early as possible, especially if accommodation is desired. Further particulars and the necessary forms may be obtained from

Dr. D. E. Rutherford,
United College,
St. Andrews,
Fife.

The Agricultural Economics Society has decided to offer two annual prizes of £10 and £5 respectively for essays on subjects connected with the economics of agriculture. Competitors must be either students at recognized institutions or holders (of not more than two years' standing) of degrees and/or diplomas in agriculture and/or economics. Essays for the current year must be sent in by March 31st, 1939, and must be on one of the following subjects :—

(*a*) A study of factors influencing changes in the size distribution of agricultural holdings in the United Kingdom since 1900.

(*b*) Agricultural credit facilities in Great Britain.

(*c*) The future of organized marketing in Great Britain.

Further details will be supplied on request to The Secretary, The Agricultural Economics Society, University of Reading, 7, Redlands Road, Reading.

We are asked to announce that the seventh International Management Congress will take place in the building of the United States Chamber of Commerce in Washington, D.C., U.S.A., from September 19th to 23rd, 1938. The Congress will be held under the auspices of the International Committee of Scientific Management, an organization which represents seventeen countries, and is being organized by the National Management Council of the United States in collaboration with other scientific, professional and industrial associations. The President of the International Committee is the Right Hon. Viscount Leverhulme. While it is not the practice of the United

States Government to sponsor officially any undertaking of this type, the Cabinet Heads and the Government Departments in the spheres of public interest touched upon by the Congress have indicated their hearty approval, and Secretary Cordell Hull of the Department of State and Secretary Roper of the Department of Commerce have promised to officiate respectively at the opening and closing sessions.

The objects of the Congress are :—

1. To provide a forum for the interchange of management experience in order to increase the efficiency of production and consumption of all forms of goods and services.
2. To appraise the present situation and probable future course of management in its broader social and economic aspects.
3. To provide an authoritative and public reminder, to management itself and to the world it serves, of the fact that the only type of management worthy of the name is that which contributes to the welfare of mankind.

There will be General Sessions dealing with the social and economic aspects of management and Technical Sessions dealing with recent developments in management; and arrangements have been made for a series of industrial tours and trips to take place before and after the congress.

Further information may be obtained from

Mr. U. Baliol Scott, British Management Council, Armour House, St. Martin's-le-Grand, London, E.C.1.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

UNITED KINGDOM—

Accountants' Magazine, March, 1938—Anglo-American trade: *E. M. Chossudowsky.*

Annals of Eugenics, January, 1938—A note on the importance of differences between examiners in the estimation of the ability of students: *J. B. Hutchinson* and *B. M. Pugh.* The stature of male school-children in relation to hair and eye colour: *M. A. MacConaill.* The sex incidence of certain hereditary traits in man: *L. Csik* and *K. Mather.* Maximum likelihood, inverse probability and the method of moments: *H. Jeffreys.* Studies on a child population, III.—Intelligence and family size: *J. A. Fraser Roberts.*

The Banker—

February, 1938—The British bank balance sheets. Hitler's five years: *W. G. J. Knop.* Silver again: *H. C. G. Slater.*

March, 1938—The future of gold, I: *R. F. Harrod.*

April, 1938—The future of gold, II: *R. F. Harrod.* Germany, Austria, Italy: *W. G. J. Knop.* Great Britain's balance of payments: *H. V. Hodson.* Mr. Keynes and the exchange account: *W. Manning Dacey.*

Banker's Magazine, April, 1938—Recent economic developments in Turkey.

Biometrika, February, 1938—Karl Pearson: an appreciation of some aspects of his life and work, Part II: *E. S. Pearson.* Bright's disease, nephritis and arteriosclerosis: a contribution to the history of medical statistics: *Major Greenwood* and *W. T. Russell.* Significance tests which may be applied to samples from any populations, III.—The analysis of variance test: *E. J. G. Pitman.* Absence and recovery recorded at irregular intervals, illustrated on school data: *Frank Sandon.* Comparison between balanced and random arrangements of field plots: "*Student.*" Note on some points in "Student's" paper . . .: *J. Neyman* and *E. S. Pearson.*

Economica, February, 1938—"Trade diversion"—an Australian interlude: *N. F. Hall.* The rate of interest and the optimum propensity to consume: *Oskar Lange.* The subsidy to British farming in respect of income tax: *Duncan Black.* A note on the pure theory of consumer's behaviour: *F. A. Samuelson.* Professor Haberler on the trade cycle: *R. G. Hawtrey.*

UNITED KINGDOM—*Contd.*

Economic Journal, March, 1938—The future of international trade: *D. H. Robertson.* The enforcement of the collective bargain in the United Kingdom: *F. Tillyard* and *W. A. Robson.* The lesson of the Blum experiment: *M. Kalecki.* Some problems of price maintenance: *T. H. Silcock.* Freight charges by road in competition: *G. J. Ponsonby.*

Eugenics Review, January, 1938—Population Investigation Committee. Hæmophilia in the Royal caste: *W. T. J. Gun.*

Geographical Journal, March, 1938—Population changes in the colliery districts of Northumberland and Durham: *A. E. Smailes.*

Institute of Actuaries, Journal, Part IV, 1937—Equities and fixed interest stocks during twenty-five years: *H. E. Raynes.* Continuous investigation into the mortality of annuitants, experience for the ten years 1926–35. The recent trend of mortality in England and Wales: *W. S. Hocking.*

Institute of Bankers, Journal, February, 1938—The control of credit in the London money market: *N. F. Hall.*

Lloyds Bank Ltd. Monthly Review, March, 1938—The short-term budget problem: *T. Balogh.*

The Manchester School, No. 1, 1938—A survey of modern monetary controversy: *D. H. Robertson.* Marketing of coal under the Coal Mines Act, 1930: *A. Roberts.* Prices and the cycles of trade: *H. W. Singer.*

Public Administration, January, 1938—The administrator and a planned society: *Sir Josiah Stamp.* Municipal wage regulation—how the joint industrial council system works: *H. C. Chamberlin.*

Review of Economic Studies, February, 1938—The divisibility of time series: *E. C. Bratt.* The uneven distribution of unemployment, I: *D. G. Champernowne.* Family endowment reconsidered: *W. B. Reddaway.* Market research, a critical study: *G. Wagner.*

Royal Agricultural Society, Journal, Vol. 98, 1937—The reorganization of marketing in Northern Ireland: *D. A. E. Harkness.* The economic history of two rural estates in Cambridgeshire, 1870–1934: *J. J. MacGregor.* Final report of pig-feeding experiment conducted on the Cambridge University farm in 1935 and 1936: *W. S. Mansfield, W. R. Trehane,* and *R. B. Peacock.*

Royal Meteorological Society, Quarterly Journal, January, 1938—Report of a preliminary statistical investigation of flowering dates of plants recorded in the phenological reports of the Royal Meteorological Society: *H. Fairfield Smith.*

Royal Sanitary Institute, Journal, April, 1938—Overcrowding: a comparative study: *Stewart Swift.*

UNITED KINGDOM—*Contd.*

Sociological Review, January, 1938—Japan's demographic expansion in the light of statistical analysis: *G. Frumkin.* Some ideas on social and psychological research: *Marie Jahoda.*

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LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part I, 1938, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS

(a) United Kingdom

Home Office. Report by the Departmental Committee on certain questions arising under the Workmen's Compensation Acts. London : H.M.S.O., 1938. 9¾″ × 6″. 115 pp. 2*s*. Cmd. 5657.

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Imperial Economic Committee. Vegetable oils and oilseeds : a summary of figures of production and trade relating to cottonseed, linseed, rapeseed, sesame seed, soya beans, ground nuts, copra, palm kernals, palm oil and olive oil. London : H.M.S.O., 1937. 9¾″ × 7¼″. 110 pp. 2*s*. 6*d*.

Industrial Health Research Board—

Reports : 81. The effects of conditions of artificial lighting on the performance of worsted weavers. By *H. C. Weston*. 38 pp.

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Overseas Trade, Department of—

Reports : 692. Tunisia, November, 1937. 26 pp. 6*d*. 693. Austria, December, 1937. 44 pp. 1*s*. 694. Denmark, December, 1937. 91 pp. 1*s*. 6*d*. London : H.M.S.O., 1938. 9¾″ × 6″. 3 parts.

Royal Commission on the geographical distribution of the industrial population. Minutes of evidence . . . first day, Tuesday, 5th October, 1937. London : H.M.S.O., 1937. 13″ × 8″. 20 pp. 2*s*.

(b) Dominions, Colonies, and Protectorates

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India—

Bombay—

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Working class family budgets in Ahmedabad, Report on an enquiry. Bombay, 1937. 9½″ × 6″. 85 pp. 5*d*.

(b) **Dominions, Colonies, and Protectorates**—*Contd.*

Southern Rhodesia—

Government Statistical Bureau—

Annual statement of the trade of Southern Rhodesia with British countries and foreign countries. 1931, 216 pp; 1932, xx + 225 pp; 1933, xxiii + 221 pp; 1934. xxx + vii + 208 pp; 1935, iv + 214 pp; 1936, iv + 220 pp. Salisbury, 1934–36. 13″ × 8″. 6 vols.

Official year book of the Colony. Nos: 1. 1924. xvi + 329 pp. 7*s*. 6*d*. 2. 1930. xx + 862 pp. 5*s*. 3. 1932. xiii + 804 pp. 5*s*. Salisbury, 1924–1932. 9¾″ × 6″. 3 vols. (From the Bureau.)

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(c) **Foreign Countries**

Bulgaria—

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Poland—

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REGISTRATION OF THE UNITED KINGDOM

No. I.—ENGLAND AND WALES

A.—Births, Deaths, *and* Marriages: *Numbers and Annual Rates per* 1,000 *persons living. Deaths under* 1 *year of age: mortality per* 1,000 *Live Births in the Calendar Years* 1933–1937 *and in the Quarters of those years.*

Years	1933		1934		1935		1936		1937	
Estimated Mid-Year Popln. in thousands	40,350		40,467		40,645		40,839		41,031 *	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	580,413	14·4	597,642	14·8	598,756	14·7	605,292	14·8	610,850	14·9
Stillbirths ...	25,084	0·62	25,209	0·62	25,435	0·63	25,045	0·61	24,776	0·60
Deaths	496,465	12·3	476,810	11·8	477,401	11·7	495,764	12·1	509,560	12·4
Marriages ...	318,191	7·9	342,307	8·4	349,536	8·6	354,644	8·7	357,886	8·7
Infant Mortality	36,960	64	35,017	59	34,092	57	35,425	59	34,917	58
Quarters	Live Births in the Quarters of each Calendar Year									
Jan.–Mar. ...	148,597	14·9	149,396	15·0	146,363	14·6	148,035	14·6	145,490	14·4
Apr.–June ...	154,047	15·3	156,513	15·5	155,892	15·4	157,652	15·5	163,867	16·0
July–Sept. ...	147,959	14·5	149,224	14·6	155,498	15·2	155,596	15·2	158,647	15·3
Oct.–Dec. ...	129,810	12·8	142,509	14·0	141,003	13·8	144,009	14·0	142,846	13·8
	Stillbirths									
Jan.–Mar. ...	6,684	0·67	6,453	0·65	6,491	0·65	6,378	0·63	6,264	0·62
Apr.–June ...	6,675	0·66	6,637	0·66	6,620	0·65	6,502	0·64	6,610	0·65
July–Sept. ...	5,902	0·58	5,979	0·59	6,304	0·62	6,067	0·59	5,991	0·58
Oct.–Dec. ...	5,823	0·57	6,140	0·60	6,020	0·59	6,098	0·59	5,911	0·57
	Deaths (excluding Stillbirths)									
Jan.–Mar. ...	169,983	17·1	146,003	14·6	132,657	13·2	153,591	15·1	163,700	16·2
Apr.–June ...	108,591	10·8	119,007	11·8	121,935	12·0	119,540	11·8	118,524	11·6
July–Sept. ...	95,810	9·4	97,469	9·6	100,066	9·8	99,935	9·7	100,295	9·7
Oct.–Dec. ...	122,081	12·0	114,331	11·2	122,743	12·0	122,698	12·0	127,041	12·3
	Marriages									
Jan.–Mar. ...	44,298	4·5	58,714	5·9	51,441	5·2	49,884	4·9	70,455	7·0
Apr.–June ...	85,597	8·5	84,956	8·4	98,388	9·7	100,621	9·9	79,795	7·8
July–Sept. ...	103,113	10·2	109,358	10·7	110,530	10·8	115,445	11·3	121,117	11·7
Oct.–Dec. ...	85,183	8·4	89,249	8·8	89,177	8·7	88,694	8·7	86,519	8·4
	Infant Mortality									
Jan.–Mar. ...	12,469	84	11,600	78	9,901	68	11,947	81	10,636	73
Apr.–June ...	8,159	53	8,671	55	8,693	56	8,583	54	8,835	54
July–Sept. ...	7,231	49	6,744	45	6,684	44	6,795	44	6,795	43
Oct.–Dec. ...	8,901	69	7,770	54	8,406	60	8,100	56	8,651	61

* Provisional.

B.—*Special Town Table*:—POPULATION; BIRTH-RATE *and* DEATH-RATE (*Civilians*) *in each Quarter of* 1937 *in certain of the* 125 *Great Towns.*

Towns	Estimated resident population, mid-1936	Annual Rate to 1,000 Living during the thirteen weeks ending							
		April 3, 1937 (1st quarter)		July 3, 1937 (2nd quarter)		Oct. 2, 1937 (3rd quarter)		Jan. 1, 1938 (4th quarter)	
		Live Births	Deaths*	Live Births	Deaths*	Live Births	Deaths*	Live Births	Deaths*
† Great towns ...	21,151,405	14·5	16·1	16·1	11·0	15·3	9·2	13·8	12·2
Including—									
London (City and Met. Bs.)	4,141,100	13·2	16·4	14·3	10·9	13·2	8·9	12·5	12·4
West Ham C.B. ...	265,800	15·8	14·4	17·5	10·3	15·9	7·5	13·8	11·3
Croydon C.B. ...	241,739	12·4	14·6	15·3	10·5	13·5	7·9	12·7	12·2
Brighton C.B. ...	146,900	12·6	16·9	14·2	11·9	13·7	9·3	12·4	14·0
Portsmouth C.B. ...	251,400	14·3	13·8	17·5	10·5	15·5	9·6	13·4	11·5
Bristol C.B.	413,900	14·0	14·5	15·6	10·6	14·6	8·7	13·3	11·6
Cardiff C.B.	221,500	14·7	13·1	15·9	9·9	15·7	8·3	15·2	11·1
Swansea C.B. ...	164,100	15·3	16·1	16·5	11·4	14·5	9·0	13·4	12·1
Wolverhampton C.B.	142,400	17·2	14·9	19·5	11·1	17·1	9·3	14·8	11·5
Birmingham C.B. ...	1,018,800	15·6	15·8	17·8	10·9	17·3	8·8	15·4	11·7
Norwich C.B. ...	123,700	13·1	14·4	15·2	10·1	14·0	9·9	11·9	11·3
Leicester C.B. ...	261,800	13·9	16·8	16·0	10·4	14·5	9·3	13·4	12·8
Nottingham C.B. ...	279,400	16·2	17·8	17·5	11·7	15·6	9·7	14·5	13·5
Derby C.B.	140,300	13·8	17·2	16·3	11·4	15·6	10·0	13·1	11·9
Birkenhead C.B. ...	148,000	15·7	17·8	17·4	10·9	17·1	8·2	14·4	11·0
Liverpool C.B. ...	846,400	19·8	17·6	21·4	11·9	19·8	9·8	18·1	14·0
Bolton C.B.	172,900	11·4	17·9	13·1	12·4	14·0	10·4	11·7	14·4
Manchester C.B. ...	744,000	15·1	17·7	14·8	12·2	14·7	10·3	13·5	13·2
Salford C.B. ...	206,000	15·6	17·3	14·7	13·0	15·3	10·0	13·9	13·7
Oldham C.B. ...	131,000	14·0	20·4	13·9	14·3	12·2	12·1	11·2	13·1
Burnley C.B. ...	91,390	10·8	19·9	12·9	13·2	11·9	11·5	10·2	14·6
Blackburn C.B. ...	116,000	10·5	21·1	12·5	14·2	12·7	10·4	10·6	13·7
Preston C.B. ...	115,200	12·3	18·4	15·1	12·7	14·1	10·9	13·4	14·0
Huddersfield C.B. ...	122,668	12·4	18·3	13·6	13·3	14·1	10·6	11·2	13·9
Halifax C.B. ...	97,330	12·2	20·8	13·9	12·4	13·1	10·5	12·4	13·6
Bradford C.B. ...	291,085	13·2	18·9	15·6	13·5	14·6	10·7	11·9	14·2
Leeds C.B.	489,862	14·3	16·7	16·0	12·3	15·6	10·3	13·4	13·5
Sheffield C.B. ...	518,200	15·2	16·9	16·1	10·4	16·4	9·0	13·8	12·5
Kingston-upon-Hull C.B.	321,500	16·7	16·5	19·1	11·5	18·6	9·5	16·2	12·0
Sunderland C.B. ...	184,179	19·0	17·0	20·7	13·2	20·1	10·3	19·5	14·1
Gateshead C.B. ...	119,034	15·8	17·1	19·8	12·7	18·0	10·1	16·7	12·8
Newcastle-upon-Tyne C.B.	290,400	15·8	16·4	17·3	12·4	17·2	9·6	15·8	13·8

* Excluding stillbirths.

† The great towns are those with populations exceeding 50,000 persons. Owing to boundary changes the numbers vary from time to time. In this table the figures relate to 122 towns for the first quarter, 124 for the second and third quarters, 125 for the fourth quarter.

No. II.—SCOTLAND

BIRTHS, DEATHS, *and* MARRIAGES : *Numbers and Annual Rates per* 1,000 *persons living. Deaths under* 1 *year of age: Mortality per* 1,000 *Live Births in the Calendar Years* 1933–1937 *and in the Quarters of those years.*

Years	1933		1934		1935		1936		1937	
Estimated Mid-Year Popln. in thousands	4,912		4,936		4,956		4,972		4,979	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	86,546	17·6	88,836	18·0	87,928	17·8	88,928	17·9	87,812	17·6
Stillbirths ...	Not separately recorded									
Deaths	64,848	13·2	63,741	12·9	65,331	13·2	66,749	13·4	68,942	13·9
Marriages ...	34,201	7·0	36,934	7·5	37,988	7·7	37.896	7·6	38,345	7·7
Infant Mortality	7,019	81	6,901	78	6,754	77	7,315	82	7,050	80
Quarters	Live Births in the Quarters of each Calendar Year									
Jan.–Mar. ...	21,785	18·0	22.744	18·7	21,978	18·0	22,514	18·3	21,591	17·6
Apr.–June ...	23,211	19·0	23.247	18·9	23,259	18·8	23,504	19·1	23,864	19·2
July–Sept. ...	21,135	17·1	21,301	17·1	21,566	17·3	21,464	17·2	21,745	17·3
Oct.–Dec. ...	20,415	16·5	21,544	17·3	21,125	16·9	21,326	17·1	20,612	16·4
	Deaths (excluding Stillbirths)									
Jan.–Mar. ...	20,750	17·1	17,406	14·3	19,177	15·7	20,196	16·4	22,123	18·0
Apr.–June ...	15,127	12·4	16,730	13·6	16.205	13·1	16,214	13·1	15,781	12·7
July–Sept. ...	13,088	10·6	13,300	10·7	13,461	10·8	13,709	11·0	13,616	10·9
Oct.–Dec. ...	15,883	12·8	16,305	13·1	16,488	13·2	16,630	13·3	17,422	13·9
	Marriages									
Jan.–Mar. ...	7,052	5·8	7,692	6·3	7,695	6·3	7,731	6·3	8,093	6·6
Apr.–June ...	8,178	6·7	8,852	7·2	9,106	7·4	9,451	7·7	9,357	7·5
July–Sept. ...	10,252	8·3	10,760	8·7	11,281	9·0	11,403	9·1	11.516	9·2
Oct.–Dec. ...	8,719	7·0	9,630	7·7	9,906	7·9	9,311	7·5	9,379	7·5
	Infant Mortality									
Jan.–Mar. ...	2,359	108	2,097	92	2,111	96	2,441	108	2,104	97
Apr.–June ...	1,706	73	1,803	78	1.655	71	1,677	71	1,733	73
July–Sept. ...	1,343	64	1,211	57	1,180	55	1,378	64	1,299	60
Oct.–Dec. ...	1,611	79	1,790	83	1,808	86	1,819	85	1,914	93

No. III.—NORTHERN IRELAND

BIRTHS, DEATHS, *and* MARRIAGES: *Numbers and Annual Rates per* 1,000 *persons living. Deaths under* 1 *year of age: Mortality per* 1,000 *Live Births in the Calendar Years* 1933–1937 *and in the Quarters of those years.*

Years	1933		1934		1935		1936		1937	
Estimated Mid-Year Popln. in thousands	1,271		1,279		1,287		1,280		1,281	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	24,601	19·4	25,365	20·1	24,742	19·5	25,909	20·3	25,416	19·8
Stillbirths ...	Not separately recorded									
Deaths	18,154	14·3	17,521	13·9	18,592	14·6	18,429	14·4	19,284	15·1
Marriages ...	7,630	6·0	8,230	6·51	8,844	6·96	9,144	7·17	8,501	6·64
Infant Mortality	1,960	80	1,767	70	2,136	86	1,992	77	1,964	77
Quarters	Live Births in the Quarters of each Calendar Year									
Jan.–Mar. ...	6,118	19·3	6,383	19·9	6,110	19·0	6,448	20·2	6,308	19·7
Apr.–June ...	6,606	20·8	6,868	21·5	6,511	20·2	6,794	21·3	6,919	21·6
July–Sept. ...	6,264	19·7	6,181	19·3	6,274	19·5	6,612	20·7	6,444	20·1
Oct.–Dec. ...	5,613	17·7	5,935	18·5	5,854	18·4	6,055	19·0	5,745	17·9
	Deaths (excluding Stillbirths)									
Jan.–Mar. ...	6,237	19·6	5,094	15·9	5,498	17·1	5,878	18·4	6,797	21·2
Apr.–June ...	4,119	13·0	4,606	14·4	4,754	14·8	4,481	14·0	4,515	14·1
July–Sept. ...	3,507	11·0	3,522	11·0	3,845	11·9	3,560	11·2	3,603	11·3
Oct.–Dec. ...	4,291	13·5	4,301	13·4	4,499	14·2	4,512	14·1	4,369	13·6
	Marriages									
Jan.–Mar. ...	1,428	4·5	1,501	4·7	1,573	4·9	1,723	5·4	1,782	5·6
Apr.–June ...	1,971	6·2	1,990	6·2	2,292	7·1	2,455	7·7	1,929	6·0
July–Sept. ...	2,266	7·1	2,508	7·8	2,620	8·1	2,784	8·7	2,669	8·3
Oct.–Dec. ...	1,501	4·7	2,207	6·9	2,325	7·3	2,307	6·9	2,121	6·6
	Infant Mortality									
Jan.–Mar. ...	682	111	539	88	726	119	622	96	616	98
Apr.–June ...	467	70	437	64	490	75	480	71	496	72
July–Sept. ...	391	62	371	60	478	76	401	61	370	57
Oct.–Dec. ...	398	71	397	67	435	74	487	80	482	84

No. IV.—ÉIRE

BIRTHS, DEATHS, *and* MARRIAGES: *Numbers and Annual Rates per* 1,000 *persons living. Deaths under* 1 *year of age: mortality per* 1,000 *Live Births in the Calendar Years* 1933–1937 *and in the Quarters of those years.*

Years	1933		1934		1935		1936		1937	
Estimated Mid-Year Popln. in thousands	2,962		2,971		2,971		2,963		2,944	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	57,364	19·4	57,897	19·5	58,266	19·6	58,115	19·6	56,564	19·2
Stillbirths ...	Not separately recorded									
Deaths	40,539	13·7	39,083	13·2	41,543	14·0	42,586	14·4	45,115	15·3
Marriages ...	13,992	4·7	14,251	4·8	14,336	4·8	14,763	5·0	14,896	5·1
Infant Mortality	3,742	65	3,664	63	3,988	68	4,309	74	4,057	72
Quarters	Live Births in the Quarters of each Calendar Year									
Jan.–Mar. ...	13,693	18·5	14,521	19·5	14,414	19·4	14,434	19·5	13,569	18·4
Apr.–June ...	15,011	20·3	15,009	20·2	14,919	20·1	15,100	20·4	15,140	20·6
July–Sept. ...	14,922	20·2	14,734	19·8	14,941	20·1	14,917	20·1	14,987	20·4
Oct.–Dec. ...	13,738	18·6	13,633	18·3	13,992	18·8	13,664	18·4	12,868	17·5
	Deaths (excluding Stillbirths)									
Jan.–Mar. ...	12,918	17·4	11,612	15·6	11,389	15·3	12,873	17·4	15,366	20·8
Apr.–June ...	9,703	13·1	10,025	13·5	10,947	14·7	10,821	14·6	11,214	15·2
July–Sept. ...	8,231	11·1	8,245	11·1	8,795	11·8	8,652	11·7	8,615	11·7
Oct.–Dec. ...	9,687	13·1	9,201	12·4	10,412	14·0	10,240	13·8	9,920	13·5
	Marriages									
Jan.–Mar. ...	3,626	4·9	3,271	4·4	3,857	5·2	3,796	5·1	3,357	4·5
Apr.–June ...	3,449	4·7	3,562	4·8	3,056	4·1	3,427	4·6	3,725	5·1
July–Sept. ...	3,550	4·8	4,035	5·4	4,157	5·6	4,183	5·6	4,194	5·7
Oct.–Dec. ...	3,367	4·5	3,383	4·6	3,266	4·4	3,357	4·5	3,620	4·9
	Infant Mortality									
Jan.–Mar. ...	1,074	78	1,169	81	1,144	79	1,234	85	1,240	91
Apr.–June ...	898	60	883	59	1,009	68	1,026	68	1,078	71
July–Sept. ...	831	56	827	56	948	63	893	60	850	57
Oct.–Dec. ...	939	68	785	58	887	63	1,156	85	889	69

No. V.—GREAT BRITAIN AND IRELAND

SUMMARY OF BIRTHS, DEATHS AND MARRIAGES *in the years* 1934–1937: *Numbers an* *Rates per* 1,000 *persons living. Deaths under* 1 *year of age*: *Mortality per* 1,00 *Live Births.*

(Compiled from the Quarterly Returns of the respective Registrars-General.)

	England and Wales	Scotland	Northern Ireland	United Kingdom	Éire
Area in statute acres (thousands)	37,340	9,462	3,488	50,290	17,254
		1934			
Population (in thousands) ...	*40,467*	*4,936*	*1,279*	*46,682*	*2,971*
Births	597,642	88,836	25,365	711,843	57,897
Birth rates	14·8	18·0	20·1	15·2	19·5
Deaths	476,810	63,741	17,521	558,072	39,083
Death rates	11·8	12·9	13·9	12·0	13·2
Marriages	342,307	36,934	8,230	387,471	14,251
Marriage rates	8·4	7·5	6·5	8·3	4·8
Deaths under 1 year	35,017	6,901	1,767	43,685	3,664
Infant Mortality rates ...	59	78	70	61	63
		1935			
Population (in thousands) ...	*40,645*	*4,956*	*1,287*	*46,888*	*2,971*
Births	598,756	87,928	24,742	714,426	58,266
Birth rates	14·7	17·8	19·5	15·2	19·6
Deaths	477,401	65,331	18,592	561,324	41,543
Death rates	11·7	13·2	14·6	12·0	14·0
Marriages	349,536	37,988	8,844	396,368	14,336
Marriage rates	8·6	7·7	6·9	8·5	4·8
Deaths under 1 year	34,092	6,754	2,136	42,982	3,988
Infant Mortality rates ...	57	77	86	60	68
		1936			
Population (in thousands) ...	*40,839*	*4,972*	*1,280*	*47,091*	*2,963*
Births	605,292	88,928	25,909	720,129	58,115
Birth rates	14·8	17·9	20·3	15·2	19·6
Deaths	495,764	66,749	18,429	580,942	42,586
Death rates	12·1	13·4	14·4	12·3	14·4
Marriages	354,644	37,896	9,144	401,684	14,763
Marriage rates	8·7	7·6	7·17	8·5	5·0
Deaths under 1 year	35,425	7,315	1,992	44,732	4,309
Infant Mortality rates ...	59	82	77	62	74
		1937			
Population (in thousands) ...	*41,031*	*4,979*	*1,281*	*47,291*	*2,944*
Births	610,850	87,812	25,416	724,078	56,564
Birth rates	14·9	17·6	19·8	15·3	19·2
Deaths	509,560	68,942	19,284	597,786	45,115
Death rates	12·4	13·9	15·1	12·6	15·3
Marriages	357,886	38,345	8,501	404,732	14,896
Marriage rates	8·7	7·7	6·64	8·5	5·1
Deaths under 1 year	34,917	7,050	1,964	43,931	4,057
Infant Mortality rates ...	58	80	77	61	72

Exports :—*Declared value of U.K. Produce and Manufactures, and of Imported Merchandise, exported from the United Kingdom in the years ended December* 31, 1935, 1936, 1937.

Countries to which consigned.	1935.		1936.		1937.	
	Exports.	Re-exports.	Exports.	Re-exports.	Exports.	Re-exports.
	£'000.	£'000.	£'000.	£'000.	£'000.	£'000.
Russia	3,483	6,244	3,507	9,838	3,083	16,433
Finland...	4,153	464	4,217	362	5,963	399
Sweden...	9,723	819	10,387	910	13,019	956
Norway, including Spitzbergen	6,623	387	7,147	252	8,937	375
Denmark,* with Faroe Islands	13,759	777	14,943	642	16,882	668
Poland, including Dantzig ...	3,792	1,309	4,862	1,710	5,698	1.925
Germany	18,940	7,446	18,980	6,816	21,624	7,301
Netherlands *	11,658	2,303	12,343	1,959	15,032	2,057
Java	1,821	39	1,985	41	2,982	49
Belgium *	8,680	4,443	9,466	4,693	11,161	5.906
France *	16,702	6,806	17,752	8,034	21,405	8,646
Switzerland	4,077	928	3.911	1,068	4,651	1,090
Portugal	4,173	229	2,776	354	3,069	400
Spain *	5,344	414	2,975	242	2,444	967
Italy *	6,799	1,356	533	408	4.941	635
Czechoslovakia	1,432	310	1,821	505	2,588	580
Greece	2,924	282	3,322	318	2,955	224
Roumania	1,213	54	1,120	45	1,813	94
Turkey	1,021	27	948	22	1,545	27
Egypt	7,631	204	7,756	183	7,883	147
China †	5,022	36	5,780	55	5,822	64
Japan ‡	4,006	132	3,564	90	4,328	384
United States	22,894	7,225	27,626	9,148	31,425	10,927
Cuba	874	18	1,019	14	1,410	18
Mexico	1,386	13	1,386	8	1,739	19
Peru	1,030	42	1,133	30	1,164	37
Chile	2,051	41	1,746	24	1,906	35
Brazil	4,757	139	4.759	107	7,055	158
Uruguay	1,516	42	1,920	36	2,310	41
Argentine Republic	15,257	344	15,266	274	20,051	349
Other Countries	28,753	1,468	28,797	1,788	34,599	2,949
Total—Foreign Countries ...	221.490	44,341	223,747	49,976	269,484	62,960
BRITISH POSSESSIONS.§						
Irish Free State	20.240	4,920	21,072	4,902	21,597	5,726
British West Africa	9,300	500	11,393	557	14,255	766
Union of South Africa (incl. South West Africa Territory)	33,662	656	37,593	704	41,535	757
British East Africa	2,921	71	3,046	—	3.977	—
British India, with Burma	37,849	623	34,122	486	39,104	529
British Malaya	7,409	155	8,363	119	11,574	173
Ceylon and Dependencies ...	3,199	80	3,207	67	3,923	91
Australia	29,338	700	32,256	723	37,531	755
New Zealand	13,359	273	17,297	347	20,253	317
Canada	21,383	1,177	23,243	1,085	27,562	1,259
Brit. W. Indies, with Bahamas	4,968	148	5,230	131	6,191	163
Other Possessions	20,677	1,659	20,036	1,672	24,608	1,670
Total—British Possessions...	204.345	10,962	216,858	10,793	252,110	12,206
Total—Foreign Countries and British Possessions	425,835	55,303	440,605	60,769	521,594	75,167

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* Excluding colonies.

† Excluding Hong Kong, Macão, Manchuria, and Leased Territories.

‡ Including Formosa; excluding Korea.

§ Including Protectorates and Mandated Territories.

Imports.—*Declared value of merchandise imported into the United Kingdom in the years ended December* 31, 1935, 1936, 1937.

Countries from which consigned.	1935.	1936.	1937.
	£'000.	£'000.	£'000.
Russia	21,764	18,903	29,097
Finland	14,915	18.145	22,452
Sweden	17,010	20.629	26.232
Norway, including Spitzbergen	8,213	8,940	11,577
Denmark,* including Faroe Islands ...	32,038	33,236	36,552
Poland, including Dantzig	7.281	9,856	10,858
Germany	30,076	33,002	36.188
Netherlands *	23,066	25,089	32,016
Java	4,303	2,557	4,674
Belgium *	15,491	18,645	22,826
France *	21,614	25,623	25,666
Switzerland	5,400	6.234	7.312
Portugal	3.121	3,856	4,319
Spain *	11,119	10,515	8,628
Italy *	7,902	2,231	7,822
Czechoslovakia	4,337	5.844	7,286
Greece	2,095	2,175	2,129
Roumania	3,218	6,233	4,548
Turkey	992	1,298	1,635
Egypt	12,726	13,543	14,360
China †	6,259	7,618	8,342
Japan ‡	8,255	9,772	11,860
United States	87,522	93.227	114,249
Cuba	3,759	5,249	4,576
Mexico	3,320	3,071	3,847
Peru	3,785	4,541	5,160
Chile	5,179	5,240	9,373
Brazil	7,194	9,844	8,539
Uruguay	3,381	3,955	3,999
Argentine Republic	43.967	45,060	59.927
Other Countries	42,180	61,259	77,854
Total—Foreign Countries	471,482	515,390	623,903
BRITISH POSSESSIONS.§			
Irish Free State	18,757	20,365	21,098
British West Africa	8,217	10.336	14,224
Union of South Africa (including South West Africa Territory)	14,029	14,174	18,874
British East Africa	3,495	4.837	5,208
British India, with Burma	41,168	51,913	64,820
British Malaya	10,887	7.002	13,160
Ceylon and Dependencies	10.031	10,076	11,619
Australia	54.286	61,435	71,805
New Zealand	38,123	43,553	49,890
Canada	56,010	75,128	88.386
British W. Indies, with Bahamas... ...	7,052	8,008	11,171
Other Possessions	22,503	25,534	34.907
Total—British Possessions	284.558	332,361	405,162
Total—Foreign Countries and British Possessions	756,041	847,752	1,029,065

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* Excluding colonies.
† Excluding Hong Kong, Macão, Manchuria, and Leased Territories.
‡ Including Formosa; excluding Korea.
§ Including Protectorates and Mandated Territories.

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LONG-PERIOD ECONOMIC TRENDS

By ROY GLENDAY, M.C., M.A.

[Read before the ROYAL STATISTICAL SOCIETY, March 15th, 1938, the PRESIDENT, the RT. HON. LORD KENNET OF THE DENE, P.C., G.B.E., D.S.O., D.S.C., in the Chair.]

INTRODUCTION.

IN a paper on *Business Forecasting: A Quantitative Investigation of the influence of money on Trade Development* which it was my privilege to read before this Society in 1932, I stressed the danger of omitting consideration of long-period changes when examining so-called "Trade-Cycle" phenomena. I suggested the possibility that the originating cause of the transverse fluctuations in production, prices and money of the "trade cycle" might be the alternation of discontinuous periods of longitudinal acceleration and deceleration which appeared to be an essential feature of the process of long-period growth. That investigation, which was confined mainly to the monetary aspect of the problem, is continued in the present paper which deals with its non-monetary aspect. I have found myself compelled to employ a method of analysing economic behaviour quite different from that customarily used by economists. For example, I expressly ignore that body of economic propositions dealing with market processes and the "forms assumed by human behaviour in disposing of scarce means between alternative processes" which provide the usual subject-matter of professional economic studies. In fact I deliberately omit all consideration of problems involving *individual* behaviour or choice. My concern is solely with those impersonal forces which give shape to economic systems, regardless of the particular personal characteristics, qualities or attributes of the individuals dwelling within them. The method of analysis which I employ is one which has proved fruitful in physics and biology. That I am ill-equipped to handle the working tools of this method I realize only too well. But I hope that the urgency of the need for a fresh and more practical avenue of approach to our social and economic problems will be accepted as a sufficient excuse for my temerity.

In the present paper the long-period economic problem is envisaged primarily as the problem of the adjustment of a population to its environment. Economic systems thus represent man's attempts to construct stable equilibria between populations and their environments. From this point of view the problems of the individual can largely be ignored and economic phenomena viewed as mass phenomena. The economic laws which this method of analysis yields are accordingly mass or " crowd " laws.

It is argued that the facts suggest that a population—unless its numbers are deliberately controlled—grows until the pressure of its numbers either produces a condition of equilibrium between it and its environment, when growth will stop; or, what is more likely, that the pressure of crowding to which this attempt to achieve equilibrium gives rise strains the system to the point of breakdown. Similar tendencies will operate in the field of the environment if it is exploited as a source of food and other human requirements. That exploitation, unless controlled, will continue to the point at which it is stopped by the pressure of the consumption-resistance of the population, or leads to a breakdown in the economic pattern of the system.

My paper suggests that the basic cause of the present breakdown in world trade is the failure to appreciate the necessity of achieving —and maintaining—dynamic equilibria of the above kind.

PART I

Primary and Secondary Laws

The economic theory developed by the English Classical School of Adam Smith and his successors is based on an analysis of the supposed behaviour of an "individual." It is believed to have demonstrated that the system best calculated on the one hand to advance individual productive efficiency and on the other to secure for the individual consumer the goods he most desires, having regard to the cost of producing them, is that known as the "free competitive price system." It assumes that, owing to the inadequacy of his resources, man cannot obtain all he requires. His means are limited in comparison with his ends, he must therefore choose between the ends. He must make up his mind what to retain and what to sacrifice. The system of *a priori* generalizations which the analysis of this problem has yielded are the so-called primary economic "laws."

But relatively early in the development of an economic system, economic growth is likely to begin to induce a sufficient element of crowding to make the assumptions of this theory in regard to freedom of individual choice and movement no longer strictly applicable. Crowding will tend to grow progressively as the economic system matures, and to play an increasingly important part in determining its long-period trend of development. The phenomena to which this crowding has given rise do not appear to have been regarded by economists as worthy of study in themselves.

This is contrary to the practice in natural science, where more attention is devoted nowadays to crowd behaviour than to individual behaviour. It is scarcely an exaggeration to say that almost all the known scientific laws relating to the long-period development of systems are secondary, or "crowd," laws.

Nowadays, when the physicist, for instance, speaks of the law of cause and effect, he merely means that a particular crowd of individual entities, which he calls atoms, electrons, or molecules, as the case may be, has moved from an initial state or arrangement, which may be called the cause, to a subsequent arrangement, which may be called the effect. When he claims to have discovered a law of nature, he means that he has discovered where to recognize or how to make a repeat pattern or arrangement of a crowd of units in the universe. This is what is implied by the statement "the same experiment always gives the same result." As of course the universe is always changing its crowd patterns, the patterns which the scientist discovers are only "like what happens in Nature."

Now, a pattern or arrangement is not something which can be discovered by a study of the separate component units. A pattern is something which is not found in any of the compartments. It is only found when the parts are viewed in association. For instance, lines and colours only achieve the quality of beauty by virtue of their arrangement in relation to one another. As Eddington has put it, "when we analyse a picture into a large number of particles of paint we lose the picture, although it can be claimed that *everything that really was* in the picture has been kept." The essence of a picture is arrangement.

Just as a picture is an arrangement of lines and colours, so, I submit, an economic system may be described as an "arrangement" of industries, and an industry may be regarded as an "arrangement" of firms.* The study of economics from this aspect may be termed *field* economics, and can be described as a method of analysing economic factors at a higher *level* of organization than that covered by primary economics. It consists in treating economic systems, not as random collections of *independent* units, but as "arrangements" of units or *wholes* actively organizing themselves. A *field* may be described as the region throughout which economic forces are active in a co-ordinated way. The field effect is constituted by the equilibrium positions of the various parts of the economic system, which bear a definite relation to one another by virtue of the fact that they are portions of the same system. The object of field laws is to describe the way in which stable arrangements are reached in economic development. The field theory thus attempts to substitute a description of economic development in terms of the dynamic concept of activity in space-time, for the static geometrical picture of primary economic theory.

Field phenomena are historically connected with ordinary primary economic phenomena, but none the less cannot be brought within the framework of primary economic laws. Within their own limits they obey different and qualitatively distinct laws. Unfortunately the description of these laws requires the use of special terms such as "organizing relations," "economic wholes," "congestion" and "economic pressure," which, though we may intuitively grasp their meaning, are not easy to clothe in precise formal definitions.

Before proceeding further let me make one matter clear, to avoid being misunderstood. When I imply that traditional economic theory has tended to overlook the effects of changes in arrangement, I do not mean to imply that traditional analysis is faulty, only that its concepts and methods of approach are different—and more limited. Amongst other things, those concepts are so defined as to compel it to deal only with momentary time-slices in an economic system's history; they prevent it from telling us anything about the historical relations of the system in time, *i.e.* about the relations of the successive time-slices to one another. On its own level one explanation may be as correct as the other. Preference in any particular case will depend on ability to assist in making predictions.

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* It should be clearly understood that by "arrangement" I do not necessarily imply that there exists any actual association or agreement between the units, but that as in the case of, say, a football crowd, a change in pressure of any kind will tend to cause all the units in the particular industrial crowd to make a change in the same direction, *e.g.* a slump will make them all turn to ways of reducing costs and a boom to ways of speeding up output.

PART II

Population Growth

It is proposed to examine first, population phenomena, and second, industrial phenomena, in order to see whether there is any justification for considering them as being subject to the same type of crowd laws as operate in physics and chemistry. Naturally since in the physical processes wherein we observe rigid conformity to a law of nature innumerable thousands, often billions, of single atoms or molecules participate, we should not expect to find the same degree of conformity or accuracy of prediction in the smaller crowds of the human world. But in theory there would appear to be no sound reason why they should not conform in *some* degree to the same laws. After all, crowd laws are deduced from perfectly general considerations which ignore any individuality in the particles concerned. They can be applied (as in the case of the quantum theory) even to problems in which the mechanism of the individual process is not only unknown but unimaginable. The gas laws of physics, for example, are quite independent of the nature of the molecules of the gas under investigation. They depend solely on assumptions in regard to such matters as the frequency with which collisions occur between molecules and the energy content of the molecules themselves.

To suggest that statistics dealing with human crowds may follow a similar mathematical course to those which relate to atoms and molecules may appear surprising, but this is perhaps only because tradition and habit have accustomed us to regard *individual* choice and free will as being the sovereign elements in human affairs.*

Actually, however, there is already a substantial body of accumulated evidence in favour of the view that animate nature under certain circumstances tends to conform to laws similar in some respects to those obeyed by inanimate nature. For example, crowds of bacteria, groups of cells, living tissues, swarms of insects, populations of plants and animals, including human beings, etc., when they grow have been found to conform in certain general respects to the same behaviour as crowds of chemical units, in what are known as "reversible" chemical reactions. And their behaviour is described by mathematical equations of the same type.

As is well known, experiments carried out in the laboratory with single populations of such elementary organisms as yeast cells and bacteria, under controlled conditions, have shown remarkable concordance with behaviour of the type suggested by what is known as the logistic equation. This equation is of the same type as that used to describe the behaviour of chemical reactions in which advance in one direction entails the production of a resistance.

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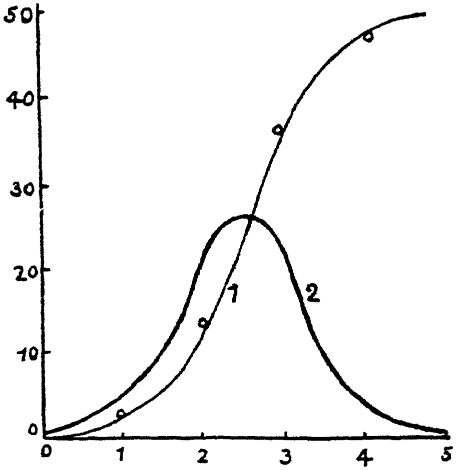
* "Man has been thought of as the Creator of Society. The scientific study of man suggests that Society as a basic feature is probably older than man. Self-conscious individuality is really a development within the matrix of Society." H. J. Fleure, *Huxley Memorial Lecture*, 1937.

If the environment is kept constant—that is to say, the new cells or bacteria are provided with the same unrestricted access to food—the population will increase in conformity with Malthus' exponential curve. No sooner, however, is the supply of food limited to a definite quantity than the steeply rising curve bends over. The rate of growth decreases, and the curve of growth assumes a characteristic S shape as it approaches an equilibrium position which represents the maximum population the environment is able to support.



The S Curve (1) Representing growth of a colony of bacteria under limited conditions.
(2) Represents the rate of growth.

Exact conformity with the logistic, it should be understood, is not to be expected, even on theoretical grounds, except in the case of a *single* population growing under the specially controlled conditions of the laboratory. In Nature a condition of equilibrium may be approached, but it will never be attained. "An everlasting ebb and flow, a mean level and a tide is our nearest approach to equilibrium." This inevitable flux and reflux—an alternation of boom and slump—can be seen everywhere. Besides, in Nature we never meet single populations, but always mixtures. It is, however, of the greatest possible assistance in understanding the behaviour of populations to know that there is a perpetual tendency for each population to conform to behaviour of the logistic type.

Until relatively recently it was assumed that under natural conditions the pressure of the population on the food supply was the factor which ultimately determined the size of population. It is now known, however, that there is a whole group of factors which can in case of need operate to check growth, so that if one set of controls either fails or is prevented from acting, another will function in its place. In the case of yeast, for example, growth ceases long before the food supply is exhausted. The inhibiting factor has been found to be the pressure of the "waste" products—the carbonic acid, alcohol and organic acids—formed as a result of the breakdown of the sugar on which the yeast lives.

In other cases, growth in density operates as a check by making populations increasingly liable to epidemics which, should they break out, will tend to continue until population density has fallen to a limiting value beyond which the epidemics are no longer able to propagate themselves. The population will then start on a fresh logistic, which will continue until there is a fresh epidemic. This phenomenon is well exemplified in the periodic sudden appearance of vast hordes of small rodents of the rapidly breeding types, and their equally sudden disappearance. Epidemics appear to have acted as the principal check on the growth of human populations in the towns of mediæval times. In other cases congestion induces psychological changes which lead to mass migration of the type with which locusts and lemmings have made us all familiar. When epidemics and migration fail to provide relief, the evidence suggests that congestion leads to control being taken over by other factors. In the case of human populations, for example, when improvements in hygiene have checked epidemics and migration fails to bring relief, resort is had to such means as infanticide, birth control, postponement of the marrying age, etc. Congestion has been found to operate as a growth-controlling factor in such widely separated types of population as drosophila, protozoa, insects, hens, wheat ears and human beings. So much work has been done on this subject that it is quite impossible in a paper of this kind to do more than refer to the subject. (See, in particular, the investigations of Raymond Pearl and his colleagues.)

The position may be generalized by saying that as growth proceeds it tends to generate opposing forces in the rest of the system in which it is taking place. These in due time reach a sufficient intensity to bring it to a standstill. A similar principle is found to operate in limiting the growth in size of structures and patterns of all kinds, including, I suggest, those of economic systems and their constituent industries.* It was discovered by Galileo over 300 years ago. It may be expressed by saying that neither can man build a house, nor Nature construct an animal or plant beyond a certain size while retaining the same proportions and employing the same materials as sufficed in the case of the smaller structure. The thing will fall to pieces of its own accord unless we either change its relative proportions, which will at length become clumsy, monstrous and inefficient, or invent some new and stronger material than was used before.

The same is true of speed. Man cannot increase the speed of a given machine beyond a certain limit—as witness the attempts to increase the speed of the aeroplane and modern Atlantic liners as at present designed. Everyone will be aware of instances of the application of this principle in his everyday experience.

The operation of the forces of congestion in slowing up population growth may be illustrated by our own experience during the period which has elapsed since the Industrial Revolution first released the present wave of growth in the eighteenth century.

The basic facts in regard to the growth of our population such as are available are so well known that it is unnecessary to recapitulate them. I have thought it sufficient to plot the totals of crude births, deaths and population on a chart in order to indicate changes in their rates of growth over the span of the life-history of our present economic system. I have plotted alongside a curve showing the output of pig iron to indicate the nature of the fluctuations in growth of production during the same period. I appreciate, of course, that this latter curve cannot be taken as affording a reliable measure of the actual rate of growth of output, especially after the close of the nineteenth century. On the births-and-deaths chart I have employed shading roughly to indicate periods of rapid growth, and black to indicate the periods when growth was slowing down, *i.e.* periods of congestion. I have taken the curves right back to the beginning of the eighteenth century, though I realize that the figures prior to 1801 in the case of population, and 1840 in the case of births and deaths, are only rough guesses. I have done this because I feel that if, as is usually done, the chart is confined to the period subsequent to 1840, it omits a vital part of the history of our population; in particular it fails to convey a picture of the trend of its long-period evolution.

In 1700, the population of England and Wales, just before it was about to start on its new adventure of growth, stood, according to Rickman's estimate, at between 5,000,000 and 6,000,000; by 1800 it had risen to nearly 9.000,000; by 1900 it exceeded the

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* See Appendix II.

stupendous total of 32,000,000! But this growth did not take place at a steady rate. The sharp increase which followed the Napoleonic wars, for example, was succeeded by a period of more or less steady decline. The population first expanded to meet the new economic environment created by the rearrangement known as the Industrial Revolution, and the agricultural transformation which accompanied it, after which the forces of congestion began to slow down the rate of growth:

	Decennial rate of increase of population. Per cent.
1801–11	14·0
1811–21	18·1
1821–31	15·8
1831–41	14·3
1841–51	12·6
1851–61	11·9

The above decline represented a falling off in the rate of increase of growth of nearly 10 per cent. a decade, if we measure from the highest point (18·1). Round about 1850 there came a sudden change; instead of continuing its deceleration, the rate of growth took an upward turn—*i.e.* embarked on a new **S** curve (shown most clearly by "births"). The percentage rates of increase in the next thirty years were:

1851–61	11·9
1861–71	13·2
1871–81	14·4

What brought about this change? There can, I suggest, be little doubt as to the answer. It was the basic changes made in the environment of our economic system. There occurred not merely a rearrangement of its internal pattern (due to the rapid linking up of town and countryside by the railway), but also an actual increase in its area due to a linking up of Britain with new virgin territories overseas. Transport facilities, which had been in their infancy in the first half of the century, were revolutionized. This period saw the beginning of the real iron age; iron ships replaced wooden, and the steamship, together with the railway, threw open the agricultural resources of the new world overseas to Europe. But for the accession of this new source of food and other materials, there seems little reason to doubt that our subsequent economic growth could never have taken place. As it was, our system ceased to be a purely national system; it was enlarged until it became an international system.

This revolution in our economic pattern—which no one could have foreseen—was, in my judgment, mainly responsible for the falsification of predictions such as those of Malthus. But there was another reason also. Malthus was mistaken in relating, as directly as he did, a population to its means of subsistence. In an *industrial* system a man's title to the means of subsistence depends on the possession of a job. If he is without a job, then however plentiful the means of subsistence may be, he will not be able to obtain a share—except perhaps in the shape of a dole. For he will be excluded from the economic pattern. Accordingly, to measure congestion we must adopt as our standard, not the availability of *food*, but of *jobs*.

There is, however, another very valuable measure of congestion—the birth rate. The birth rate is subject to control by the individual, while the death rate will usually depend on the arrangement of the population *as a whole* in relation to the environment as a whole. If, for example, hygienic conditions are improved, the death rate will tend to fall irrespective of the wishes of the individual, except in so far as he has of his own free will brought about the improvement in hygiene. The birth rate (and, it may be added, the marriage rate) will be more within the control of the individual. Thus it is that in times of congestion, when epidemics or other natural enemies have failed to check numbers, recourse is usually had to some form of birth or marriage control.

It should be realized that the degree of congestion required to induce action will be relative to the conditions of the environment. Man will strive both to maintain and improve his *existing* standard of living. If his efforts begin to meet with opposition he is—if he is a thoughtful person—unlikely to wait until he has actually lost much ground before he starts control. How sensitive an index the birth rate can be is shown by the close correlation between price movements and the birth rate during the nineteenth century. Periods of rising prices, as is well known, are periods of expanding incomes and opportunities of betterment, and falling prices periods of contraction in incomes and congestion in employment. Our experience during the nineteenth century shows this clearly. Udny Yule, writing of this period, said: "I feel myself compelled to the belief that the course of prices, either directly by its influence on consuming power and on profits, indirectly by its effects on trade, or more indirectly (if it be possible) as an index to the course of some other variable, has been through the past century the factor of most outstanding importance in the rate of reproduction of the race." *

The renewed rise in the birth rate which began in the 'fifties continued until the 'seventies, when it was succeeded by a decline.

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* Udny Yule, "Growth of Population and the Factors which Control It," *J.R.S.S.*, 1925, Vol. LXXVIII, Part 1.

The effect on population growth is reflected in the population figures, whose percentage rates of increase were :

1871–81	14·4
1881–91	11·6
1891–1901	12·2
1901–11	10·9

What were the causes of this fresh decline? The answer, I suggest, may be summed up in the word "congestion." Congestion from the point of view of a population will appear not as a single, but as a group of causes. When people seek to find a *single* cause to account for the present decline in our birth rate, they appear to be wasting time.* We have already observed that a population by its own growth tends to generate forces which oppose further growth. The nature of those forces and the way in which they will affect a *particular* individual cannot be forecast. What we can forecast is that, as these forces of congestion increase in intensity, they will affect the behaviour of a steadily increasing number of individuals (each of whom, according to his particular circumstances, will tend to take steps to resist them), until the point is reached at which the growth of the population as a whole will be affected. If the death rate is prevented from providing the required check, owing to epidemics having been brought under control, then the task devolves on the birth rate.

After the middle of the 'seventies there were many factors operating to cause congestion. The falling trend of prices meant that there was an inducement to the wealthy to strive, by limiting the number of their offspring, to conserve for themselves and their descendants the standard of wealth which they themselves had attained. Among the working classes there were such things as the limitation of the hours of work of children and the education acts—children ceased to be an asset and became a liability. There were, of course, other factors also. Meantime improvements in hygiene were beginning to reduce the death rate, and this in due time intensified the pressure in the labour market among those seeking jobs.

Some idea of the extent of the increase which can occur in the supply of labour, as a result of a period of high birth rate followed by a period of declining death rate, may be illustrated by noting the effect on the supply of adults in the case of our own population in the years which followed the period of high birth rate immediately preceding 1876.

Taking the adult labour population as consisting mainly of males between, say, 20 and 55 years of age, we find that their numbers increased by 10 per cent. between 1851 and 1861, by 12 per cent. between 1861 and 1871, by 14 per cent. in the two following decades, and by no less than 19 per cent. during the ten years 1891–1901.

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* As congestion is a crowd phenomenon, it must have a pattern of causes which changes progressively in *time*.

Now, this quite abnormal rate of growth in the supply of labour was independent of, and clearly could bear no relation to, the "demand" there would be for it when it would in due time appear on the market—that is, some 15 to 20 years after it was born. The increase was the result partly of the prosperity existing in the period 1850–75, and partly of something which had nothing whatsoever to do with trade and employment—the fall in the death rate. Obviously unless there occurred an altogether unprecedented demand for labour, this rapid and uncalled-for increase in the supply would tend "to disturb the market for it, emphasize the problem of unemployment at every recurring depression, and tend to lower both marriage- and birth-rates among the wage-earning classes." *

If we examine the position from the demand side, we find that social records point to the existence of a progressive increase of pressure in the labour market—if we except temporary boom periods—from the year 1873 right up to the Great War; though the pressure was not so strong as in the post-war years. In those days employment could be spread by reducing wages. But even so, the congestion was sufficiently intense that the rise in prices between 1896 and 1913, together with the renewal of foreign investment and migration associated with the opening up of new overseas areas of food supply, was unable to relieve it. Indeed, real wages fell during this latter period (though there was some shifting of occupation towards the higher wage groups), and the birth rate took a fresh downward plunge.

PART III

Economic Arrangement: A Population and its Environment

Thus far our examination of the problem of economic growth has been concentrated mainly on a description of population changes. We have only related these by inference and in passing to changes in environment. It is now time to give this latter aspect of the problem fuller consideration.

A population and the environment in which it lives combine to produce a complex *historical* equilibrium, in the sense that their future behaviour cannot be determined without a knowledge of their special past histories. As a result of the operation of the forces which maintain this equilibrium, there emerges a structure or pattern which constitutes what we mean when we speak of a social or economic system. Accepting the established principles of natural science, it can be taken for granted that the equilibrium of this pattern will remain unchanged unless it is affected by external causes. This is Newton's law of motion stated at the biological level.

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* Udny Yule, *loc. cit.*

If growth is to occur in any part of the system, for example, there must be an alteration in the arrangement of this pattern. To assist in an understanding of what this implies, an attempt must be made to state more precisely what is meant by "arrangement," as applied to economic systems.

What are the relations, for example, between the arrangements which we call economic systems and their constituent unit factors? Because traditional economics has given little attention to the problem, it is usually supposed that the former are merely a summation of the latter. There have not been wanting, however, even economists who have felt qualms on the matter.*

For example, when we add together factors as in mechanics, we can predict the resultant *a priori*, but when we form a new pattern, *i.e.* a compound, as in chemistry, we can usually neither predict the result nor discover any relation between the properties of the compound and those of the elements.

The explanation is that compounds usually reveal properties which are *not* a mere summation of the properties of the separate constituent units. As in beauty and melody, the new properties arise from rearrangement.

There is a difference in the mode of operation, though the elements are the same.

The compounding of economic factors into arrangements or systems results in similar discontinuous changes in properties. For our present purpose the only changes of which we need take note are those which result in releases of additional output. That is to say, cases where something apparently appears out of nothing. Twice two no longer makes four, but five and more.

Let me attempt to illustrate the type of discontinuous economic change I have in mind by referring to a phenomenon familiar to everyone—harvest fluctuations. It will be agreed that it is possible for a given agricultural area to be planted in exactly the same way in one year as in another, and to receive exactly the same quantity of sunshine and the same quantity of rainfall, and yet in one year to yield a bumper harvest and in the next a failure. The result will depend on the *order* in which the component factors have been arranged. If, for example, the rain precedes the sun, there may be a bumper harvest; if the order is reversed, there will almost certainly be a failure. The *quantitative* relations of the factors will be relatively unimportant. Thus the *same* economic factors arranged in a different way give a *different* result. A change in the basic plan of a country's system of agriculture will produce a long-term discontinuous change in output of a similar kind, though it will take longer than a single harvest to come into full bearing. The addition of factors in amounts which *quantitatively* are quite unimportant can produce changes in output equally startling. The action of soil fertilizers provides a good example of this. In agriculture "the substance which is present in a minimum quantity in relation to the needs of the plants determines the amount of the crop."

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* Professor F. A. Von Hayek, writing on Economics and Knowledge, observes: "... I have long felt that the concept of equilibrium itself and the methods which we employ, pure analysis, have a clear meaning only when confined to the analysis of the action of a single person, and that we are really passing into a different sphere and silently introducing a new element of altogether different character when we apply it to the explanation of the interaction of a number of different individuals" (*Economica*, Feb. 1937).

An alteration in arrangement of an appropriate kind will provide a discontinuous release of additional output. For example, the substitution in the eighteenth century of the four-course rotation for the mediæval open-field system of agriculture caused a sudden jump in our capacity to produce food. The application of power achieved the same result for industry in the nineteenth century. The steam engine was a special arrangement of iron, water and coal, which caused a sudden jump in our capacity to speed up the production of goods; the introduction of the railway and the steamship resulted in a sudden jump in the speed of capacity to move goods. Factories were *qualitatively* different from the units of handicraft labour and capital which they grouped together, and their outputs were not quantitatively related. The absence of a relatively unimportant invention—as measured by, say, its capital cost—can, on the other hand, hold up progress for a considerable time. The steamship and the railway were powerless to release for consumption in Europe the vast meat-producing potentialities of the Argentine until cold storage was invented. Each of the above rearrangements and inventions involved a sudden jump in the speed of output which bore no direct relation to the amount of labour and capital employed; nor, as will be noted later, to the rate of growth of consumption. In all these cases *there was no simple arithmetical relation between the output of the factors employed before and after the rearrangement.**

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* The importance of the issues which this raises will be clear when it is remembered that many important propositions in current economics rely on the assumption that such arithmetic relations *do* exist. For example, Mr. R. F.

In all cases of rearrangements of this kind the forces of growth, previously held in check, are released. This growth will generate counter-pressures in the remainder of the system which, as we saw in the case of population growth, will ultimately lead to the movement being checked. These pressures and counter-pressures are, I believe, among the principal formative influences in giving economic systems their patterns. For whenever pressures are released by a change in arrangement in one part of an economic pattern, steps have to be taken by the rest of the pattern to adjust itself to the new conditions, if breakdown of the whole long-period pattern is to be avoided.

In the case of a bumper harvest, for instance, either the extra output of food must be fitted into the existing pattern of the system by, say, closer packing (*e.g.* by cutting prices to a point at which the food will be absorbed by (*i.e.* packed into) existing consumers' incomes), or it must be stored, *i.e.* isolated to prevent it from exerting pressure, for the time being, on the pattern; or it must be removed permanently by burning it or allowing it to rot *in situ.* In a modern economic system still another avenue of escape from the pressure of unprovided-for output often exists. That is to remove the surplus from the economic pattern, or part of a pattern where it is superfluous, and transfer it to some other pattern by way of a loan to be repaid later in the form of some *other* commodity for which there will be space available in the original pattern. An economic system thus reacts to a change in pressure in the same way as a chemical or physical system, in accordance with what is known as Le Chatelier's Principle or the law of mobile equilibrium.*

The foregoing assumes a more or less static economic situation, *i.e.* one in which change is resisted. But an economic system in which growth is taking place, it will be obvious, cannot confine its activities merely to resisting changes of pressure in its various parts. Growth means change; that is to say, the pattern must give way to the forces of growth. There will, of course, be limits to the extent to which this will be practicable without upsetting its

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Harrod, in the preface to his recent book on Trade Cycles, says, "There is a well-established relation, vouched for by experience and the *laws of arithmetic*, between the demand for consumable goods and the demand for durable goods." Referring later to this relation he asserts (p. 55), "Thus if consumption were advancing at the rate of 2 per cent. per annum, only half as much net investment would be necessary as would be required to sustain an advance of 4 per cent.'' I deny that this is necessarily the case.

* This law states that in any physical system, which is in stable equilibrium, the exertion of any force which tends to alter the disposition of that system will bring into operation forces tending to maintain the *status quo*. For instance, if the decomposition of a chemical substance involves an increase in volume, an artificially produced increase in pressure will inhibit the decomposition, and vice versa.

long-period order. This means that even when new growth is allowed to occur, it must be checked when it has reached a certain point, if the basic stability of the pattern is not to be destroyed.

If a new wave of population growth, for example, is to make headway, it will be essential that there should be a corresponding alteration in the capacity of its environment to support numbers, *i.e.* there must be an increase in its output of food. It must either acquire new virgin territory of an appropriate kind, or steps must be taken to rearrange its existing economic pattern to enable it to grow more food. Unless the environment is modified in one or both of these ways, there can be no long-period change in the size of the population, but only intermittent fluctuations about a mean. Thus, like the population it has to maintain, the environment, considered as a source of food supply, must be subject to new growth. A population and its environment are thus *complementary* parts of a single whole. One cannot suffer a long-period change without the other. Nevertheless it does not follow that, once growth has started, it will proceed at the same *rate* in both. For the natural rates of growth of a population and its food supply respectively will not necessarily be determined by the same factors. An increase in the birth rate of a human population, for example, will not deliver a supply of fresh adults until twenty years later; the opening up of a new agricultural area, or adoption of a new system of agriculture, on the other hand, may deliver a supply of additional food in less than half the time. Fluctuations will accordingly tend to arise from the necessity of maintaining some kind of equilibrium between these two streams of growth. Fluctuations of population and environment of the above type have been investigated among marine animals. This has led to the discovery of what is known as Volterra's law. Let us take two fishes, one feeding on the other—call them shark and cod. While the shark are few, the cod multiply. When cod are plentiful, the shark wax fat, and multiply in turn. Their predacious hordes play havoc with the shoal of cod, and at length the shark go short of food and dwindle. The few cod left have time to breathe and breed again; and a fresh cycle slowly begins. So far as I am aware, the same problem has never been worked out in detail in the case of a human population and its food supply. But we know from experience that intermittent fluctuations of the above type do occur.

It will be clear that there will be an optimum rate of exploitation for a food supply, which will be represented by the turning point on its logistic curve when it passes from a progressively increasing to a progressively diminishing rate of growth. If more is taken out of the environment than this, there will be progressively deterioration in its capacity to deliver food. Similarly there will be an optimum population for a given food supply. This will be the smallest number of individuals able to consume the optimum output. The whaling industry, which affords a practical illustration of this kind of problem, has been studied by Professor Johan Hjort and his colleagues:[*] The rate of reproductivity of the whale is slow, and technical improvements in the efficiency of the whaling industry have made it possible to catch more whales than its reproductivity permits. The total catch of whales has on many occasions greatly exceeded the optimum catch. "Where this has been the case, the continued rise in the total catch was rendered possible by the increased number of catchers and men, by an increased population. Nevertheless, the catch per boat and the men's standard of life has steadily declined—a sure sign that the stock of whales was being ruined although the total catch was rising."[†] The only way out of the difficulty appears to be to restrict the number of expeditions. To permit competition to continue would involve either a reduction in the standard of life of everyone in the industry, or the maintenance of that of a few at the cost of a progressive elimination of the remainder from employment.

But, as in the case of population growth, even where the point at which returns begin to diminish has still to be reached, it does not follow that exploitation of the environment will proceed indefinitely at the maximum rate. There will be a limit to the rate at which a population can absorb food or other products of the environment. If food output proceeds faster than this rate, it will cause congestion among food-producers. This congestion, as in the case of population, will lead to a rearrangement of units within the economic system which will lead to growth being checked. This will be true whatever the nature of the output. As we shall see later, the same principle seems to operate even in the case of an ordinary industrial manufacturing industry.

PART IV

Growth of Industries

The birth of a new economic system according to our method of analysis implies a rearrangement, with or without additions, of the elements of the existing pattern of such a kind as to release forces of growth in particular parts and in particular directions. This growth will continue till it meets an opposing force which it itself generates in the process of growth. Growth will then slow down, and the system will strive to settle down to a new position of equilibrium.

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[*] See Vol. XX, *Conseil Perm. Int. pour l'exploration de la mer, Copenhagen,* etc.

[†] *Huxley, Memorial Lecture,* 1934.

As a system grows, its pattern will increase in complexity as well as in size. Its shape will be a compound of the struggles between, on the one hand, the competing elements within the internal environment of the system itself, and, on the other, between the system as a whole and the external environment. As in the case of a population, our problem is not one of dealing with the life-histories of single industries, but with those of a mixture of industries. Thus, as in the case of population also, it will be practically impossible under natural conditions for an individual industry to form a plateau at its apex, *i.e.* to conform to the logistic. Once the forces making for the advance of a particular industry cease to gain in relative strength over those opposing growth, the latter will tend to surpass them. This growth will be accompanied for a time by a more or less continuous addition of new commodities; these also in most cases will be likely to restrict the increase in demand for old commodities. The faster these newer industries expand the greater will be this restrictive influence, and the more difficult it will be for the new industries themselves to sustain their initial rate of progress. Retardation also will occur, partly because the new industries compete directly with the older industries, and partly as a result of their attracting to themselves the nourishment, *i.e.* capital, labour, and materials, which might otherwise have gone to sustain the older industries' growth. Deterioration and the operation of the law of diminishing returns in the case of natural resources will be other potent factors making for deceleration. Invention, on the other hand, will tend to offset this deterioration. But, as in the case of the maintenance of the output of exhausted soils by adding artificial fertilizers, there will be a limit to the effectiveness of invention. Since Watt and Smeaton reduced the coal consumption of steam engines from 30 lbs. per horse-power to 9 lbs., no genius has found a way of making a reduction of a further 21 lbs.! No matter how spectacular future improvements in transport may be from the engineering point of view, they cannot possibly reduce costs to the same absolute extent as did the steamboat and the railway. Professor Kuznets* in his survey of the technological histories of Cotton, Woollen and Worsted, Iron and Steel, Boot and Shoe, Paper, and Copper industries found that the rate of technical progress in each of these except Copper had been slackening, and it is doubtful whether Copper is still an exception.

Similarly there are limits to which industries experiencing

* *Secular Movements in Production and Prices.*

retardation will be able to offer resistance by organizing technical research and instituting intensive sales and advertising campaigns. Incidentally, in so far as they are successful, they are likely to exert a retarding influence on other parts of the system.

A typical life-history of a branch of industrial manufacture, for example, may be summarized as follows :—

A new invention is made which greatly reduces the cost of production of some article. This releases a new stream of output. The *individual* firm which is the earliest in the field will flourish and make money. But it cannot count on maintaining its exclusive position. In due course the invention will spread *throughout the industry*. Under a system of open competition output will be increased and prices fall until the profit per article falls to normal.

So long as sales can be increased more than in proportion to the fall in price, the aggregate profits of producers will expand. But for every article a point will eventually be reached beyond which sales will fail to expand further in proportion. The industry will find itself threatened with loss. As this point is approached, certain firms, to resist the check to growth of output, will amalgamate, *i.e.* there will be a closer packing of units, which will enable the amalgamating firms to maintain, for a time, their position at the expense of their fellows, by producing more cheaply. Ultimately, however, the bulk of producers will find themselves compelled to associate together in resisting further price-cutting by agreeing to restrict output and maintain prices in the industry as a whole. New entrants also will have to be controlled, as also will the introduction of still newer inventions. The workers on their side are likely to form Unions to maintain wages.

The advent of this condition, it should be clearly understood, cannot be evaded by a general expansion of demand in terms of money, *i.e.* by money inflation. As R. G. Hawtrey has rightly observed, there may be cases in which the stage of elastic demand is extended, but there will be others in which the stage of inelastic demand is actually hastened. " The idea that, even if all restrictive practices are discarded, an indefinite amount of inflation can be met by an indefinite expansion of output is a fallacy." *

Long-period changes similar to those in the field of production will occur on the consumption side also. Thus the relations of production and consumption in an ordinary industry are similar to those of a population and its food supply, one cannot continue to grow unless the other does so also. Just as there is a limit to the

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* *Capital and Employment,* p. 309.

rate at which a population can absorb the food provided by its environment, so there is a limit to the *rate* at which consumers can absorb the output of producers in an ordinary industry. Temporary disharmonies will arise in this case also, because the rate of growth of one outstrips that of the other. The intermittent hold-ups which are necessary to allow a time interval to elapse for the re-establishment of equilibrium between production and consumption—when they cover an important section of the industrial field—have been studied in primary economics in connection with what is known as the Trade Cycle.*

What in fact has been the experience in these respects?

It is unfortunately not possible to provide completely satisfactory evidence, owing to the absence of the requisite statistics. Neither in point of quantity nor of quality are the listed long-range production series of any of the principal countries adequate for a proper enquiry into production trends, even if its scope is restricted to the physical volume. But the tentative conclusions which are all that the limited material available will permit strongly support the conclusion that as the decades pass the rates of growth of industries tend to decline. The most complete enquiry is probably that made by Dr. Arthur F. Burns for the United States, covering the period between 1870 and the present day.† The following data collected for the U.K. should be regarded as supplementary to the evidence already obtained in the above enquiry; they are too feeble to stand on their own feet.

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* The hire-purchase system is a good example of a "rearrangement" which can set in train a production–consumption (*i.e.* a "trade") cycle. Consumers, whose incomes prior to this invention did not permit of the purchase of such things as motor cars, refrigerators, etc., except after accumulating savings over a number of years, find themselves *suddenly* provided with the means of obtaining such goods immediately. Production and consumption are thereby *both* accelerated. But to maintain the rate of acceleration in consumption by a flow of fresh hire-purchase customers after hire-purchase facilities have passed into general use, will be quite impossible. Demand may then fall back to its earlier rate of expansion, with the result that motor-car and refrigerator manufacturers will find themselves left with plants speeded up to produce the needs of, say, two or more normal years in one. If hire-purchase facilities have been extensively employed over the field of industry, a general slump in trade is to be expected in due course.

Waves of long-term investment can set up similar oscillations, *e.g.* the overseas investment booms of the nineteenth century; at these times it was production which tended to lag behind.

In the nomenclature of primary economics the intermittent fluctuations in which consumption tends to grow faster than production are sometimes referred to as inflation–deflation cycles; those in which production tends to increase at the faster rate are sometimes termed over-investment–under-consumption cycles. The former, the boom phases of which are usually marked by a sharp rise in prices, especially in constructional materials, are characteristic of a youthful economic system, the latter, in which this feature need not be present, of one approaching old age.

It cannot, of course, be assumed that even if production and consumption accelerated and decelerated at the same pace, there would not be discontinuities. For the pattern of an economic system will be made up of a sequence of separate and discontinuous quanta of growth which will occur *in turn* in its various parts, and at different stages in its history.

† *Production Trends in the United States since 1870.*

Dr. Burns used the physical output of commodities and services as shown by Annual Statistics of the United States. One hundred and four series were employed, 20 for agriculture, 3 for fisheries, 22 for mining, 45 for manufacturing, 2 for construction, 7 for transportation and 5 for trade (but there is a certain amount of duplication). It is estimated that in the year 1925 the series covered just over 40 per cent. of the commodity-producing industries. Of the 104 continuous series analysed, 92 show retardation; of the 43 supplementary discontinuous series, 38 show retardation. In most cases the rates of retardation are appreciable. The exceptions are mostly industries of secondary importance. As a rule the industries which have grown most rapidly show the most rapid rates of retardation, and the industries which have grown least rapidly the lowest rates of retardation. Rapid industrial growth has thus been attained, generally at the cost of rapid decline in the rate of growth. The problem of measuring this retardation is not easy, for it has by no means been a regular process.

The method used by Dr. Burns was as follows :—

He (1) views the decade rates of a given production series as observations at quinquennial dates on the rate of growth of that series, (2) writes the decade rates in ratio form, (3) fits a straight line to the logarithm of these decade rates, the equation being $\log y = \log a + (\log b)x$, where $\log y$ refers to the decade rates centred at quinquennial dates and x to quinquennial dates, and (4) integrates the equation of this straight line. He thus obtains the equation of a parabola fitted to the logarithms of the original data. The constant of integration can then be determined by invoking the criterion of the zero moment.

Since the antilog of $\log b$, where $\log b$ is the first derivative of the above straight line, is equivalent to the term b in the exponential function $y = ab^x$, the average rate of retardation is obtained by calculating b in this function, referring to quinquennial data and to decade rates centred at quinquennial dates, the curve being fitted by the method of moments to the decade rates taken in ratio form.

It is unnecessary to describe in any detail the various mathematical methods which are normally used in the analyses of growth; but in order to make clear the manner of treatment of the production or consumption data for particular trades of the U.K., I wish, in passing, to state that I have fitted a logarithmic parabola to each of the series.

The logarithmic parabola

$$\log y = c + (\log a)x + \frac{\log b}{2}x^2 \quad . \quad . \quad . \quad (1)$$

reports through log b the degree of acceleration or retardation of growth. For differentiating (1) we obtain

$$\frac{1}{y}\frac{dy}{dx} = \log a + (\log b)x$$

and fitting a straight line to the rate of growth we provide log b.

The logarithmic parabola may be fitted to the production series by various methods. The method which I have used for the British data is that of least squares. Although more laborious than that employed by Dr. Burns in his study, it tends to under-estimate the average rate of retardation.

This does not, of course, affect the general thesis. We are concerned, not with the exact magnitude of the rate of retardation, but only with providing evidence to show that forces exist in an industrial system which cause retardation in the rate of growth of its industries.

Unfortunately the number of British items for which figures are available over a long term of years is very limited. The seven items which I have selected for investigation may, however, I suggest, be regarded as representative from the point of view we have in mind, as well as affording useful corroboration of the American data.

The British series which I have examined are set out in Appendix I. The logarithmic parabola fitted to the statistics is as follows :—

Pig Iron $y = 8{\cdot}6455402 + 0{\cdot}0169505x - 0{\cdot}0001163x^2$ . . (i)
Steel $y = 5{\cdot}0840922 + 0{\cdot}1820219x - 0{\cdot}0022897x^2$ . . (ii)
Coal $y = 1{\cdot}5756456 + 0{\cdot}0232545x - 0{\cdot}0000474x^2$ . . (iii)
Wheat $y = 4{\cdot}5202748 + 0{\cdot}0138344x - 0{\cdot}0000741x^2$ . . (iv)
Cotton $y = 4{\cdot}5334133 + 0{\cdot}0200633x - 0{\cdot}0001455x^2$ . . (v)
Wool $y = 5{\cdot}6910912 + 0{\cdot}0146596x - 0{\cdot}0000205x^2$ . . (vi)

The origin of each of the aforementioned is centred at 1867.

In addition to the above, I have taken meat consumption, the data for which are not available before 1876 (which has been taken as the origin). It gives the following primary trend curve.

$$y = 4{\cdot}1152703 + 0{\cdot}0631466x - 0{\cdot}0007182x^2 \quad . \quad . \quad (\text{vii})$$

Analysing the equation

$$\log_e(\text{commodity}) = a + bx + cx^2$$

for each commodity, we obtain the following results :—

Pig Iron.

$$y = 8{\cdot}6455402 + 0{\cdot}0169505x - 0{\cdot}0001163x^2 \quad . \quad \text{(i)}$$

$$\frac{dy}{dx} = 0{\cdot}0169505 - 0{\cdot}0002326x$$

$$\frac{d^2y}{dx^2} = -\,0{\cdot}0002326$$

Steel.

$$y = 5{\cdot}0840922 + 0{\cdot}1820219x - 0{\cdot}0022897x^2 \quad . \quad \text{(ii)}$$

$$\frac{dy}{dx} = 0{\cdot}1820219 - 0{\cdot}0045794x$$

$$\frac{d^2y}{dx^2} = -\,0{\cdot}0045794$$

Coal.

$$y = 11{\cdot}5756456 + 0{\cdot}0232545x - 0{\cdot}0000474x^2 \quad . \quad \text{(iii)}$$

$$\frac{dy}{dx} = 0{\cdot}0232545 - 0{\cdot}0000948x$$

$$\frac{d^2y}{dx^2} = -\,0{\cdot}0000948$$

Wheat.

$$y = 4{\cdot}5202748 + 0{\cdot}0138344x - 0{\cdot}0000741x^2 \quad . \quad \text{(iv)}$$

$$\frac{dy}{dx} = 0{\cdot}0138344 - 0{\cdot}0001482x$$

$$\frac{d^2y}{dx^2} = -\,0{\cdot}0001482x$$

Cotton.

$$y = 4{\cdot}5334133 + 0{\cdot}0200633x - 0{\cdot}0001455x^2 \quad . \quad \text{(v)}$$

$$\frac{dy}{dx} = 0{\cdot}0200633 - 0{\cdot}0002910x$$

$$\frac{d^2y}{dx^2} = -\,0{\cdot}0002910$$

Wool.

$$y = 5{\cdot}6910912 + 0{\cdot}0146596x - 0{\cdot}0000205x^2 \quad . \quad \text{(vi)}$$

$$\frac{dy}{dx} = 0{\cdot}0146596 - 0{\cdot}0000410x$$

$$\frac{d^2y}{dx^2} = -\,0{\cdot}0000410$$

Meat.

$$y = 4{\cdot}1152703 + 0{\cdot}0631466x - 0{\cdot}0007182x^2 \quad . \quad \text{(vii)}$$

$$\frac{dy}{dx} = 0{\cdot}0631466 - 0{\cdot}0014364x$$

$$\frac{d^2y}{dx^2} = -\,0{\cdot}0014364$$

The average rates of retardation are therefore as follows :—

	Average Annual Rate of Retardation	%	Average Decennial Rate of Retardation	%
Pig Iron ...	0·00023	0·023	0·00233	0·233
Steel	0·00459	0·459	0·04686	4·686
Coal	0·00010	0·010	0·00095	0·095
Wheat	0·00015	0·015	0·00148	0·148
Cotton	0·00029	0·029	0·00291	0·291
Wool	0·00004	0·004	0·00041	0·041
Meat	0·00144	0·144	0·01447	1·447

The statistical evidence pointing to a retardation of the rate of growth of these individual items confirms the general impression which can be gained from a study of the history of industry in general. The utility of the above evidence lies in the fact that the data themselves have not been subjected to any statistical adjustment prior to the determination of the extent of the retardation phenomenon.

It is true that charts containing unadjusted annual data over a long period of time present important difficulties of interpretation in the matter of trend, owing to large or small intermittent fluctuations, but, as will be seen later, despite this apparent obscurity, it is possible, by drawing growth lines, to deduce, though roughly, the points of time at which the rate of growth actually underwent a process of retardation. The logarithmic parabola, of course, only provides the annual rate of growth of the *primary trend* of output over the whole segment of history.

No separate industry is expected to conform throughout its life to the trend rate of growth, but it can be deduced from the mathematical analysis of the data that when the data diverge substantially from the trend curve—that is to say, when the data indicate a period of retardation or acceleration in the rate of growth in excess of the primary trend rate of growth—the output will suffer a pressure or check for a period so that it again conforms to the rate of primary trend growth at that stage of history.

This reaction in the rate of growth is also to be found in American industry. To illustrate this general phenomenon I have computed from *Production Trends in the U.S.A.*, by Dr. Burns, a table showing the retardation in the growth of a selected number of industries in that country.

Retardation in the Growth of Industries in the U.S.A.

Series	Period covered by Series	Measures of Retardation	
		Average Rate (per cent. per decade)	Stage (years from 1930)
Cotton	1870–1929	−0·8	2
Wool	1870–1929	−0·8	−14
Wheat	1870–1930	−0·5	− 5
Tobacco, raw	1870–1929	−0·3	36
Copper	1870–1929	−2·2	3
Zinc	1870–1929	−1·7	10
Coal, total	1870–1929	−1·4	2
Cement, total	1880–1929	−1·3	37
Locomotives	1880–1929	−3·1	−28
Pig Iron	1870–1929	−1·2	13
Zinc consumption ...	1873–1929	−1·0	35
Steel	1870–1929	−3·4	− 1

Furthermore, the logarithmic parabolas fitted to the original production data provide the measure of the period taken in arriving at the stage when each series passes through a maximum. That is to say, maximum value for y in the function $y = a + bx + cx^2$ can be determined by equating its first derivative to zero. It must not be assumed from this that the industries will thereafter cease to grow, or that they have passed their zenith, though either may actually have taken place. It can be said, however, that if growth continues, new forces are operating probably exterior to the industry, whose effect may be of short duration, which are causing the industry to undergo an unnatural growth.

It will be seen that by a comparison of the U.K. and U.S.A. data, the decennial percentage rates of retardation for the industries of both countries prove a close order of magnitude.

PART V

Growth of an Industrial System

Is it possible to draw similar deductions in regard to an economic system as a *whole*?

The answer is that reliable data on which to base a conclusion are even more meagre than in the case of individual industries. We cannot assume without corroborative evidence that decline in the rate of growth of *individual* industries implies a decline in the rate of growth in the *aggregate* of producton of an economic system as a whole. Theoretically a decline in the growth of individual industries could be quite consistent with expanding growth in the aggregate. Indeed, the more vigorous and progressive the system, the more marked might this divergence in trend become.

Several attempts have been made to compile indices to represent changes in the rate of growth of *total* output of an industrial system, especially in the U.S.A. All of them are of very doubtful value. Quite apart from difficulties of compiling such an index number and reducing a series of as widely differing items as bales of cotton, tons of steel, number of motor-cars, etc., to a common unit of measurement, there is the problem of securing an adequate sample of industries with widely differing decade rates of growth. It is agreed that even the best of these indices gives inadequate representations to new industries, and to by-product and recovery trades. These omissions all tend to give a downward growth bias to the indices. This bias, it is true, is to some extent offset by the omission and the under-representation of decadent industries. To what extent one offsets the other it is not possible to say. We possess little or no information in regard to the " birth rates " of new industries and the "death rates" of old. The average life-span of industries is probably becoming shorter. A growing proportion of production is taking the form of tertiary products, luxuries and superfluities, the demand for which has not the same stability as the demand for staples.

We shall be erring on the right side if we assume that all these indices under-state the rate of growth in production. At the same time it must not be forgotten that, accustomed as we have been to living in a progressive world, any suggestion that the growth of production as a whole is tending to decline will meet with a strong psychological resistance. One has the feeling, for example, that Dr. Burns himself has been influenced by this psychology. Thus, despite the extent and spread of the retardation shown by his investigations, he feels it necessary to record his belief in the persistence of progress by concluding his analysis in the following terms: "If there has been any decline in the rate of growth in the total physical production of this country (*i.e.* the U.S.A.), its extent has probably been slight and it is even mildly probable that the rate of growth may have been increasing somewhat." No factual evidence in support of this conclusion, however, is provided in his book.

So far as the U.K. is concerned, any conclusions based on direct industrial evidence must be even vaguer, since our data are even more limited. At the same time I would venture to suggest that it is a mistake to regard indices for "total" production as being wholly without value. In the first place, there should be nothing surprising either from a theoretical or practical point of view in the suggestion that industries do not continue to grow for ever by geometrical progression. In the second place, as I hope to show presently, the conclusions to which these indices appear to point are supported by other evidence.

Figures for two of these indices—one for the U.K. and one for the U.S.A.—have been plotted in the form of trend curves in the Appendix. That for the U.K. is compiled from "An Index of Industrial Production for Great Britain since the Eighteenth Century," by Dr. Walther Hoffmann of Kiel,* and that for the U.S.A. is reproduced, by the kind permission of Professor Warren Persons, from his book *Forecasting Business Cycles*. The American chart, which is much the more detailed, shows clearly how decline in the rate of growth has successively affected the different classes of items comprised in the production pattern. From 1920 to 1930, for example, production of the leading minerals was still expanding at a 6 per cent. rate, while the leading crops were down to nearly

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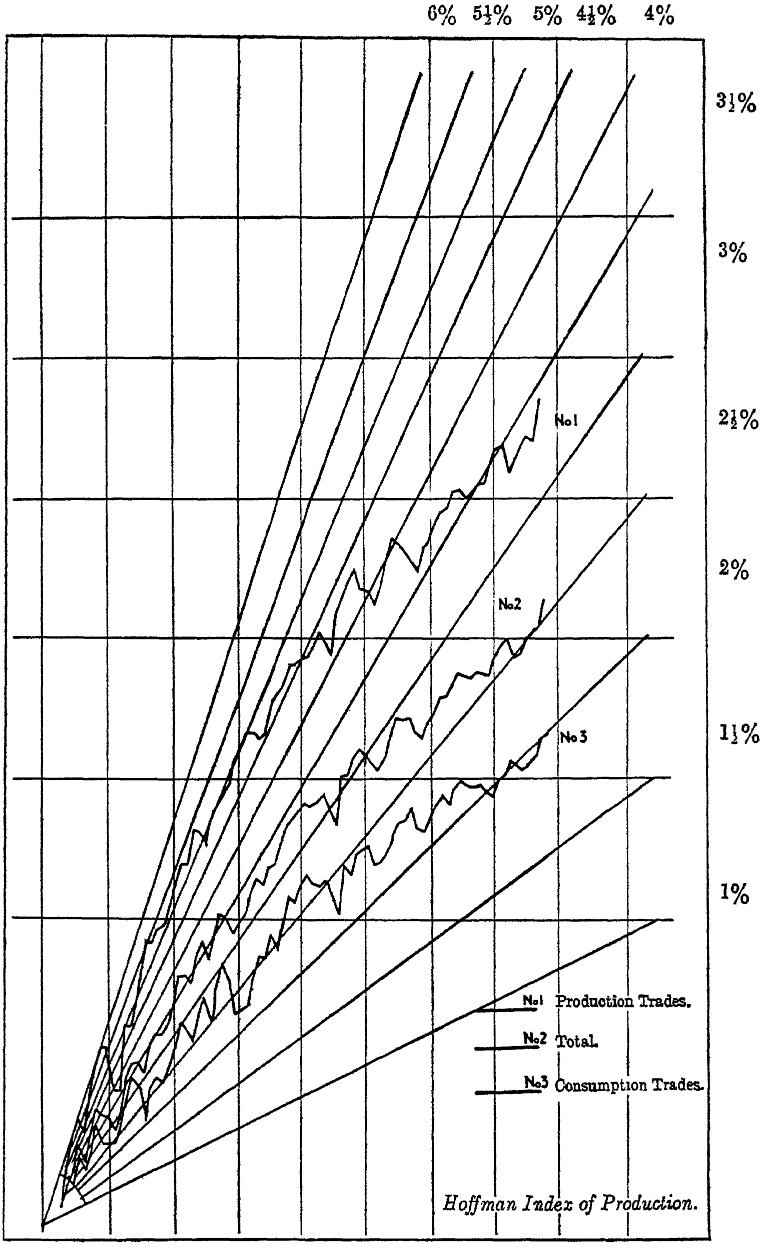
* *Weltwirtschaftliches Archiv*, Bd. 40, Heft 2, 1934.



Growth of U.K. production (1830–1910).

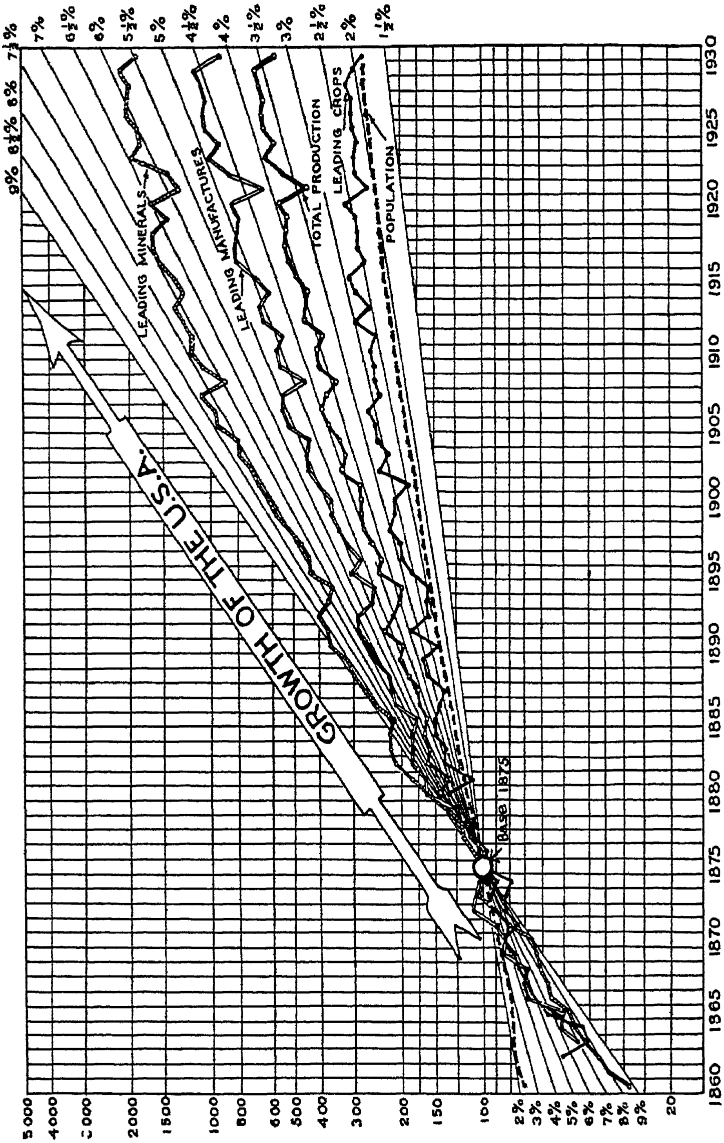


CHART E.

The Growth of the U.S.A., 1860–1930.

2 per cent. Perhaps one of the most significant features of both charts is the circumstance that changes in the rate of growth appear to take place by a series of discontinuous steps. Each of these step-downs in rate has coincided with an occasion when the economic pattern of the country concerned is known to have undergone a fundamental change in arrangement.

The products of the soil, it should be noted, do not conform to this industrial pattern. They possess a marked individuality arising out of the basic conditions of agricultural production, which permit considerable mobility in agricultural resources.*

The U.S. growth curves exhibit the decline in the rate of growth of industrial output by a series of abrupt step-downs much more clearly than the U.K. curves. An explanation of this difference which obviously suggests itself is that basically the U.S. economic system has in the main remained a self-contained unit, whereas the original U.K. domestic pattern became largely merged into an international pattern. Using the curve for " leading minerals " as our guide, we find that the rate of growth in the U.S.A. remained relatively stable from 1875 to 1883. It then stepped down to a somewhat lower level which was maintained till about 1893. A further step-down then occurred to a level which was maintained until 1907. After that the rate of growth began to fall away more rapidly, though owing to the activity of the war period the movement did not become pronounced till after 1920. The other industrial curves reflect the same tendency. It will be noted that in the boom years immediately preceding the slump which ushers in the step-down there is nearly always a temporary acceleration in the rate of growth.

The above movements conform well with what we know of the changes in America's industrial environment.

Until about 1875 both wealth and income were fairly well distributed among the people as a whole. So long as labourers had the choice of taking up free land in the west or working for employers, wages continued to rise. After 1876 free land and other free resources disappeared. Men began to be replaced by automatic machinery and industries became more concentrated. By 1882 monopolistic combinations of large enterprises had begun to appear in some of the major industries—closer " packing " was being resorted to in an endeavour to sustain the rate of growth.

The business crisis in 1884 was almost entirely confined to the United States.

In 1893 the United States experienced its most severe crisis up to that time. The over-building of railroads and the over-settlement of the north-western part of the country were acknowledged to have been outstanding contributory causes. Thereafter the monopolistic tendency in the mineral and manufacturing industries grew at a rapid rate.

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* See Dr. Burns, *loc. cit*, p. 207.

By 1907, when the next major crisis occurred, the American industrial system had reached a point at which most of its major industries were developed to the stage where they had capacity of production in excess of the quantity of products which could be sold at prevailing prices. Business continued in a more or less depressed condition until the opening of the World War.

In the case of the U.K. we find, starting with 1845, that, excluding cyclical fluctuations, the rate of growth remained substantially unchanged until about 1865; it is possible there may have been some slowing down even before 1860, but the exceedingly disturbed political conditions of the period make this difficult to determine. The crisis in 1866, which was followed by a step-down in the rate of growth, appears to have been largely confined to the U.K.; and was short lived, owing to continuing expansion elsewhere. The revival which followed was due primarily to *external* causes, in particular the American demand for goods. From the period 1865 onward overseas trade and investment began to play an increasingly important part in our fortunes.* Our national domestic pattern became merged into a larger international pattern.

After the international crisis of 1873, however, deceleration was resumed, its rate increasing after 1877. The temporary revivals in the rate of growth between 1879–83 and between 1886–89 were all primarily the result of expansions in our overseas activities. There appears little reason to doubt that but for these external " enlargements " of our environment the decline in the rate of growth would have been faster. There was a further step-down after 1889. A fresh decline which began in 1899 was held in check until 1908 by the marked revival in foreign investment from 1903 to 1907. This was the " last and greatest campaign of capital export " ever undertaken by this country. It was devoted mainly to the opening up of new—but less favourably situated—sources of food supply, and to the equipment with machinery and other appliances of countries destined to become increasingly our industrial rivals.

For Britain the year 1900 appears to have marked a turning-point in a number of respects. During the two previous decades the terms of international barter had been increasingly favourable to Britain—" more and more wheat or timber for the same bit of steel work or bale of cottons." After 1900 they became less favourable. In addition, a number of younger—and therefore more vigorous—industrial nations were challenging Britain's supremacy in manufacture.

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* For details see my paper "Business Forecasting," *J.R.S.S.*, Vol. XCV, pt. I

A number of conditions at home also suggest the approach of a condition of congestion, after the house-building boom of the late 'nineties was over. Some of Britain's older primary industries, for example, appeared to have passed the optimum point on the curve of improving efficiency.

Mr. G. T. Jones, who made a detailed investigation of three industries—iron and steel, cotton and building—found that in each of them the tendency to increasing average output per head had practically come to an end by 1900.* It is true that we managed to maintain more or less full employment for the employed classes as a whole, so that new occupations—and migration—must have been able to absorb those being displaced. But, as has already been pointed out, this precarious balance was achieved only at the expense of a check in the standard of living.

Mr. Colin Clark, in his *National Income and Outlay*, refers to data which he has prepared showing the growth of income per head of the occupied population between 1830 and 1913. This, he says, "tended to conform to a curve of the type known as 'logistic.' There can be no doubt about the trend in the years before 1913, supported as this evidence is by auxiliary data, namely a strong slowing down in the rate of increase. The curve was approaching a definite ceiling." But Mr. Colin Clark also goes on to assert that "during the years since then, something has happened to break that ceiling, and that the *fraction of our resources which we care to employ* again gives a rapidly increasing yield" (the italics are mine). He adds that "at the present time we have only ourselves to blame for a large part of our troubles. With a reserve of labour of 2 million workers, we must not complain if our output per head is not higher than it is." This is where I find myself parting company with him. I take the view that the nineteenth-century economic system—I mean the international system—has reached a crisis in its fortunes. The fact that it has become broken up into the number of smaller national systems, which we see being formed to-day, has, I submit, been no mere accident. It was something inevitable, predictable and inescapable, once its growth curve had reached a certain point.

This has not been understood because we have been prone to regard an economic system as a random *collection* of industries instead of, as I suggest, a long-period historical *arrangement* of industries, whose basic long-period pattern must be maintained if the co-ordinating forces at work throughout the system are to function properly, and breakdown is to be avoided. The element of order and stability necessary for the maintenance of equilibrium in an economic pattern is, I venture to suggest, an economic system's most precious possession, for on it will depend not only the prospect of the continuing survival of the system in time, but also the possibility of elaborating on it, as a foundation, a still more complicated structure.

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* *Increasing Returns*, Cambridge University Press, 1932.

From this point of view changes in the fortunes of particular industries, or constituent parts of the economic system, must be followed, not separately. but concurrently. They must be treated as contributions to a common pattern; they are significant only when viewed as parts of a single harmonious *whole*; they have (in this connection) no meaning as so many separate items.

The pattern of an economic system, as is well known, is constructed by a process of subdividing and specializing economic operations in both space and time.

This subdivision and specialization of industry involves either a voluntary or a compulsory restriction of the freedom of individuals—they must become units in a pattern. Now, it will be essential to the maintenance of equilibrium in this pattern that the *complementary* relations between the various parts of the system should be maintained throughout its period of growth. The group responsible for producing, say, food, must not encroach on the work of the group to which is delegated the task of producing, say, clothing materials. If it does so, then the whole arrangement will become like an organism affected with cancer—growth in one part will be at the *expense* of, instead of complementary to, that in another.

In the early stages of an economic system, it is true, the question of maintaining complementary order in the system will not be important. The resources still to be exploited will be considerable, the area available for free growth large, while the population will be growing rapidly; so that even should, say, the food producers encroach on the work of the clothing material producers, there need be a temporary hold-up only while demand catches up supply; while any individuals displaced in the process of adjustment can readily find occupation in some new trade or other part of the pattern. When, however, the critical point on the growth curve is approached, encroachment by one group is likely to involve serious disturbance and loss to the other. When this point is reached, two things can occur. Either the growth curve can be allowed to continue its course, which will involve a slowing down, showing itself in over-production, unemployment, etc., or there must be a re-arrangement of the pattern as a whole. In my opinion the slowing-down stage is beginning to arrive, and some countries are already choosing the second alternative. To make work for their unemployed, and for reasons of national security, the industrial nations of Europe have started to provide for themselves at home the food which used to be produced for them by their agricultural opposite numbers in the international pattern, located in the newer countries overseas. These latter in their turn have been driven thereby to accelerate the domestic manufacture of industrial products of the type previously imported from Europe. This in its turn has reacted on the industrial countries of Europe, and caused a still further intensification of their nationalistic policies. International growth has thus become competitive instead of complementary. This form of growth has already eaten so deeply into the old international trade pattern that that pattern has probably been disrupted beyond all hope of repair.

The industrialization of overseas agricultural areas was not of course wholly a post-war development, for it had begun even before the Great War. A factor not without influence in this respect has been the change in both the rate of growth and age-distribution of the populations of Western Europe. This has been responsible for reducing progressively Europe's capacity to absorb overseas outputs of food as rapidly as they can be produced.*

The maintenance of the basic pattern of an economic system will require that order be maintained in *time* as well as space. Rules of complementary growth accordingly must govern the introduction, in the course of the system's life-history, of new and more efficient methods of production also. Here again, with a new population and a new environment there will be little difficulty. Men released from one occupation at one stage of development are readily absorbed in another belonging to the next stage of progress. As, however, the system approaches maturity, experience suggests that progress from one stage to another tends to become more difficult. New occupations become harder to provide at the appropriate rate, especially as there is likely to be a tendency for the elimination of labour in the lower levels of the pattern to be speeded up as machinery is increasingly used to overcome the sales resistance which, as we have seen, develops in them as the economic system matures.

In our system to-day, for example, basic industrial occupations are said to be already ceasing to provide new openings for workers fast enough because, owing to sales resistance, industrial production is not able to expand as rapidly as the individual output of workers employed.

A report issued by the International Labour Office in 1935 states that "in the United States, Great Britain, Japan and Norway industrial occupations are so crowded that they have ceased to attract the new elements in the population." This condition has been partly obscured by the fact that some—but not all—of those displaced or not required in industry have, for the time being, been finding employment in distribution, services, etc.* But obviously there must be a limit here also, especially as increasing costs of distribution and services tend to eat progressively into the savings in costs made possible by the improvements in productive efficiency. Sooner or later there must be a rationalization of distribution also accompanied by a reduction in its labour needs.† This means that the internal equilibrium of our economic pattern is being threatened with breakdown, also, especially if it be true, as I have suggested elsewhere, that an increasing proportion of our energies is being devoted to what I have called "negative" work—that is to say, work whose purpose is, not to add new amenities to our environment, but to attempt to restore those of which we are being progressively deprived by the steadily increasing congestion of our urban areas.‡

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* See Dr. Snow's paper, *J.R.S.S.*, Vol. XCVIII, Pt. II, 1935.

The growth of a modern economic system may be summarized as follows:—

Like the population for which it provides, the output of an economic system, it may be permissible to assume, will begin by tending to grow by geometric progression. After a time, however, growth will begin to meet with resistance. Goods will tend to be produced at a faster rate than they can be absorbed. In an endeavour to maintain the earlier speed of absorption, producers will organize into larger units to reduce costs by eliminating labour and other charges.* This means that a certain number of consumers will be thrown out of the system (*i.e.* those displaced from employment). To speed up consumption, selling will be organized and consumers encouraged to consume more rapidly by means of sales campaigns, advertising, the provision of consumers' credit, etc. These additional items will increase costs of distribution, and these latter in time will begin to offset the reduction in costs being made on the production side, *i.e.* there will be no further fall in selling prices. That is to say, under both methods production will be speeded up, while the rate of consumption will tend to slow down relatively. To devise still cheaper methods of distribution will not assist, for this will involve throwing workers out of employment, *i.e.* a further decrease in the number of consumers will occur.

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* The Report of the Sub-Committee on Technology of the National Resources Committee of the U.S. House of Representatives states that "the notable expansion in employment which took place between 1920 and 1929 was due almost entirely to the rapid growth of service activities; their occupational requirements differed so widely from those of the basic industries which registered declines that it is extremely unlikely that all the workers displaced from the basic industries obtained new jobs in the service industries." The extent to which new invention is tending to drive the speed of industrial production faster than that at which consumption can keep pace in the U.S.A., the largest producing country in the world, is indicated by the following: "If the productivity of 1935 (the latest year for which figures are available) continues the same in 1937, and the composition of the nation's total product remains unchanged, production would have to be increased 20 per cent. over that of 1929 to have as little unemployment as existed then." Of special interest from the point of view of the argument of this paper is the circumstance brought out by the analysis that the growth in labour productivity since the War, instead of being spread over the whole period, was concentrated almost entirely in two short spurts during the depressions of 1921–22 and of 1931–33.

† See discussion at last year's meeting of the British Association opened by Professor Sargent Florence. Also, *Retail Trading in Great Britain*, by Henry Smith, who gives an index of total costs of retailing which shows a rise of from 100 in 1924 to 162 in 1931. This increase, he says, was "considerably greater than the growth of productive efficiency during the period could have justified."

‡ See discussion on Dr. Snow's paper, *loc. cit.*

The only way of escape from this vicious circle would be to provide new avenues of *complementary* employment for those displaced. But there will be a limit here also. Sooner or later the point will be reached when avenues of new employment cannot be provided rapidly enough to absorb at existing wage levels those displaced from both production and consumption. These persons will then begin to compete for *existing* employment, instead of entering new. That is to say, the structure of the economic pattern will begin to break down. It will be like a body afflicted with cancer.

The last stage in this strange eventful history will be reached when either the system begins to disintegrate or producers begin to resist attempts to make them work faster, and consumers attempts to make them consume faster. Both will prefer leisure. Leisure means they will refuse either to produce more, or to consume more.†

As in the case of the long-period changes in evolution of individual industries (see section IV), money inflation is more likely to hasten than slow down the advent of this condition.‡

In conclusion, I should like to place on record my indebtedness to A. L. Please for his generous help not only with the statistical material, but also with the general subject-matter of this paper.

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* I omit consideration of wage reductions as these do not involve changes in arrangement. Besides, the effect on consumption will be obvious.

† That the exercise of leisure does in fact create a measure of additional production and consumption is beside the point. It is outside the purpose for which the pattern of the economic system was devised. It cannot prevent, but may accelerate its breakdown.

‡ See Appendix III.

APPENDIX I

SOURCES OF U.K. PRODUCTION DATA

Steel Production Pig Iron Production	Annual Statistics issued by the British Iron and Steel Federation in the report entitled *Statistics of the Iron and Steel Industry.*
Coal Production.	Annual Statistics given in Report of the Secretary of Mines.
Wheat Consumption.	Home production less domestic exports plus imports less re-exports, compiled from the Agricultural and Trade Returns of the U.K.
Raw Wool Consumption.	Sheep and lambs' wool of home and overseas production retained in the U.K. compiled from the Annual Statement of Trade and tables issued by the Bradford Chamber of Commerce.
Raw Cotton Consumption.	Estimate of Total Consumption of the U.K. taken from statistics issued by Messrs. Ellisons & Co.
Meat Imports.	Extracted from the *Annual Statement of Trade.*

APPENDIX II

GROWTH AND FORM *

The problem of growth and form is an extremely complex one; and it can only be touched upon briefly in a paper of this kind. Its nature, however, may be indicated by treating an economic pattern as if it were a purely "physical" pattern. In this sense, the form and the changes of form that are apparent in the development and growth of an economic system can be regarded as being due to the action of force. Thus the form of an economic system is a "diagram of forces."

We are taught by elementary mathematics that, in similar solid figures, the surfaces increase as the square and the volumes as the cube of the linear dimensions.

Taking the single case of a sphere with radius r, the area of its surface is equal to $4\pi r^2$, and the volume to $\frac{4}{3}\pi r^3$; from which it follows that the ratio of volume to surface, or V/S, is $\frac{r}{3}$.

In other words, the greater the radius (or larger the sphere) the greater will be its volume or its mass in comparison with its superficial area. And, taking L to represent any linear dimension, we may write the general equation in the form—

$$S \propto L^2, \; V \propto L^3,$$

or

$$S = KL^2 \text{ and } V = KL^3;$$

and

$$\frac{V}{S} \propto L.$$

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* See Thompson, D'Arcy W., *Growth and Form.*

From these elementary principles a number of important consequences follow. In the first place, though growth in length (let us say) and growth in volume are parts of one and the same process, the one attracts our attention much more than the other. For instance, a fish, in doubling its length, multiplies its weight by no less than eight times; and it all but doubles its weight in growing from four inches long to five. In the second place, *scale* has a marked effect on physical phenomena. We are accustomed to think that magnitude is so purely relative that differences in magnitude make no other or more essential difference. This is by no means the case. The effect of scale constitutes what is known as the principle of similitude, or of dynamical similarity. This effect of scale is simply due to the fact that, of the physical forces, some act either directly at the surface of a body, or otherwise in *proportion* to the area of surface; and others, such as gravity, act on all particles, internal and external alike, and exert a force proportional to the mass, and so usually to the volumes, of the body.

The same principle applies to bodies in motion. There is a steady, progressive diminution of activity with increasing size.

The form of an organism is determined by its rate of growth in various directions caused by the transference of portions of matter into the system from without, or from one widely distant part of the system to another. Every part of the system will have its own specific rate of growth referred to a particular direction. It is the ratio between the rates of growth in various directions by which we must account for the external form of the system.

The velocities in different directions must tend to maintain a *ratio* which is more or less constant if the system is to maintain its form. The ratio will not be absolutely constant, but will tend to alter or fluctuate in a regular way; and to these progressive changes are due the changes of form which accompany development.

Comparative anatomy is largely the study of the struggle to increase surface in proportion to volume. "For every type of animal there is a most convenient size, and a large change in size inevitably carries with it a change in form."

Small animals like mice cannot live in cold climates. They need a food supply proportional to their surface to keep warm, and their bulk is too small for them to be able to consume the requisite quantity of food.

On the other hand, increase the dimensions of a small animal ten-fold in every direction and its weight is increased a thousand times. If its shape is unaltered its surface will be increased only a hundred-fold, and ten times as much oxygen will have to enter per minute through each square millimetre of skin and ten times as much food through each square millimetre of intestine, if it is to use its muscles as efficiently as its miniature counterpart. Above a certain size the surface of these organs will be too small to deal with this rate of intake. The same will be true of excretion. The same rules govern the construction of man-made appliances. If the linear dimensions of an aeroplane are increased, it must fly twice as fast to keep in the air; the power needed to keep it up increases more rapidly than the weight of the machine; for every type of aeroplane design there will be a limit to the practicable speed.

In so far as an economic system possesses a physical structure, similar internal struggles between bulk and area will arise if its pattern is allowed to grow beyond its convenient size. As its radius increases the volume of goods and people it contains will tend to expand in proportion to the cube of that radius. But its avenues of distribution and centres of consumption, though they may be increased proportionately, can only be increased by the square of that radius. To enlarge them still further will be impossible without a complete change in the form of the system as a whole. The point is well exemplified in the present transport situation in a city like London.* As its radius has increased we have widened and duplicated its roads, but the volume of traffic to be carried has tended to increase more than in proportion. The point has been reached in certain areas where the roads cannot be widened still further without encroaching on the housing space—and other amenities—of the consumers whom these avenues of transport are intended to serve. If these consumers are to maintain—and continue to raise—their standard of living, they must be rehoused without an increase in their rent—or rates. This can only be done by building blocks of flats on the restricted sites, to be filled partly by the old tenants of the area, who now have to be satisfied with less space, and partly by *additional* tenants (*i.e.* tenants from outside the area), who must be brought in to assist in defraying the cost of the new building, if the older tenants are not to be mulcted of excessive rents. These additional numbers will tend to re-congest the roads recently widened. Attempts to overcome this problem by speeding up the movement of transport will encounter similar difficulties; while to construct still more overhead, surface or underground roads will be to impose a burden of debt (*i.e.* a tax) on users which will become increasingly disproportionate to the benefit conferred as congestion increases. What is true of a single town is true of an economic system as a whole.

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* The inhabitant of London who, thirty or forty years ago, was perhaps two or three miles from rural amenities, is now as much as ten miles, or even more, from direct contact with the open country. It is true that transport facilities are more numerous and more rapid, but their cost is so high that the poor cannot afford to make frequent use of them. "Moreover, numerous as the facilities are on the few occasions when the industrial worker is free to take advantage of them, there is such congestion that the fatigue and length of the journey well-nigh neutralizes any advantage to be gained from the outing." (See evidence given by L.C.C. to Royal Commission on Geographical Distribution of Population.) See also evidence by Mr. Frank Pick on behalf of the L.T.B.

Much ink has been spilled over discussions as to whether one type of economic system is better than another. The truth appears to be that there is no *absolute* standard. Everything is relative. In each case the population—unless deliberately controlled—will grow until pressure produces a condition of equilibrium between it and its environment, when growth will cease. Similarly the output of goods from the environment will grow until it is stopped by the consumption-resistance of the population. What we term "progress" is merely the interval of disturbance which elapses while the population moves from one condition of equilibrium with one environment to another condition of equilibrium with another environment. Since the position of equilibrium reached (except in cases of shortage or where epidemics exercise a check) is determined by pressure of congestion, it nearly always means that either population growth or output growth will have passed the optimum point before growth stops.

An economic environment may be likened to a village hall and the population to the villagers making use of it. Used for a cinema performance, the hall can conveniently hold more people than when used as a dance hall, and, as a dance hall, more than when used to accommodate, say, a sale of work. Obviously it will not be practicable to institute absolute comparisons between these three ways of using the hall. There will, however, be general agreement that an essential factor in determining the personal happiness of the individual user in all three cases will be the degree of congestion permitted. If too many people are allowed to occupy the hall, then everyone will be uncomfortable, whatever may be the purpose for which it is being used.

Experience teaches us that a population will always tend to over-crowd its "hall" unless deliberate steps are taken to control its numbers in time. This explains why mankind has always failed to attain the Utopia of its dreams.

As Malthus observed, when pointing out that corn countries are more populous than pasture countries, and rice countries more populous than corn countries, "happiness does not depend on their being thinly or fully inhabited, upon their poverty or their riches, their youth or their age; but on the proportion which the population and the food bear to each other." In the case of our village hall and industrial systems of to-day, we should substitute for the word "food" the phrase "general amenities of life," including in this the degree of personal freedom afforded to the individual.

The circumstance that congestion, when it begins to make itself felt, leads in the first instance to closer "packing" of units and—in a system like our own where there is a wide divergence between rich and poor—to re-distribution of space, opportunities and resources, helps to conceal from the *average* individual what is really happening. To-day, for example, instead of realizing that it is congestion that compels him both to live in flats instead of houses and to submit to many other forms of closer "packing," he is induced to believe that these things represent a *rise* in what is termed his "standard of living."

Similarly he fails to realize that the poor can never attain the standard of living of the rich of to-day. That standard, in fact, progressively recedes from their reach the more they strive to attain it. Nowadays the difference in standard is depending increasingly on the enjoyment of such things as ampler space, rare luxuries, fashions which cease to be an object of desire once they are thrown open to the many, and, lastly, personal services which can only be afforded so long as there is a wide gap between the income of master and servant—in other words things which tend progressively to disappear as the distribution of the national income becomes more equal.

APPENDIX III

NOTE ON THE LONG-PERIOD MANAGEMENT OF MONEY

A remedy which is sometimes suggested for this condition, of what one may perhaps term "chronic" under-consumption, is an all-round increase of wages. Unfortunately unless new inventions are proceeding at the same rate *throughout the economic system*, this could not fail to disorganize seriously the production–consumption relations in those parts of the economic pattern where costs are not being reduced by invention. But this is not the only objection in the case of a *mature* economic system, where as a result of a progressive redistribution of wealth the wage level is already relatively high. In this case an all-round increase of wages might under certain circumstances even lead to a *fall* in *real* purchasing power. For it would be likely to cause such a substantial rise in the prices of certain of the necessary elements in the basic standard of living—*e.g.* land rent, transport and service charges—as to reduce the quantity of purchasing power available for use in other directions. (The standard of living, it must be remembered, is not a *random* collection of *separate* items. It is an "arrangement" of items, so that alteration of prices in one part of its pattern can affect prices of the remainder adversely.) From the long-period point of view, the only useful function of an *all-round* increase in wages would appear to be to bring about a better distribution of wealth between rich and poor. A possible exception to this generalization is the case where an economic pattern is being enlarged or undergoing a fundamental change in "arrangement." At such times a rise in wages (and prices), provided it is not forced artificially, will help to impart a valuable element of mobility to assist in the redistribution of labour and occupations in the enlarged pattern.

Nor will it be wise, in the interest of productive efficiency, to increase wages in *individual* industries, except gradually. At the peak period of invention in the nineteenth century there were many cases where profits would have justified a *sudden* doubling or even trebling of wages, while still leaving the manufacturer a very substantial profit. But it is very doubtful whether to have done so would have had the desired effect on consumption. A workman faced with a sudden doubling or trebling of his wages is more likely to cut down his hours of working than to work harder in order to consume more. For it must be remembered that the goods likely to tempt him to spend more will in all probability not yet be in existence, as it will not pay anyone to embark on their manufacture until *after* a sufficient number of his fellows have also had their wages raised to a corresponding extent.

A similar condition will govern the savings-investment relation.

To regard savings made by manufacturers in times of invention or inflation as rewards for the exercise of the *personal* virtues of thrift and abstinence is quite misleading, despite the assertions of those who have made the profits. The profits earned in periods of new invention are windfall-profits—that is to say, *unprovided-for* profits. To spend them in personal consumption would be profligacy; to invest them involves no serious self-denial at all: in fact, no sound alternative is open to the prudent man. Equally it will be reasonable to reinvest them in extending the use of the *same* invention, for not only will this be the direction in which profits are highest, but here again there is likely to be no sound *alternative* able to absorb them *fast* enough. (I except gilt-edged investments and mortgages which, *in this connection*, cannot be regarded as "investment.") As the use of the new invention spreads, however, the rate of profit will decline (that is, will conform to an **S** curve), and so naturally also will savings and the stimulus to further investment. Thus savings and investment accelerate and decelerate *together*. What is true of an individual invention will also apply to the long-period investment of the economic pattern as a whole.

This explains the well-known correlation between prices and the long-term rate of interest. Here again, of course, as in the case of the production-consumption relation, temporary disharmonies will arise periodically between savings and investment which will disturb the even trend of the long-period curve. In a young economic system the tendency will be for investment to grow faster than savings; in a mature system the position will be reversed. But to restore equilibrium in the latter case will not be easy, as by the time this stage of evolution is reached alternative avenues to investment proper, offering greater security, will be increasingly available for the *hoarding* of savings, *e.g.* Mortgages, State and Municipal loans, etc. (see chapter 5 of my *Economic Consequences of Progress,* section on Usury).

DISCUSSION ON MR. GLENDAY'S PAPER

MR. R. G. HAWTREY: It is a great pleasure to me once more to hear and to speak upon a paper by Mr. Glenday. I think we all appreciate the exuberance of his ideas and the liberal amount of material that he gives us for discussion and, indeed, for thought.

In Part II of the paper, about population growth, it seems to me that Mr. Glenday has rather neglected migration and assumed a little too easily that the forces at work are concerned only with birth and death rates. To give one illustration, on p. 521 he contrasts the rate of growth in population in the four successive decades ending with 1911, but he does not mention that the decades ending 1891 and 1911 were periods of substantially heavier emigration than the others. And emigration has to be correlated with economic conditions overseas.

When he comes to the growth of industries, he gives a very elaborate statistical analysis, of which the starting-point is the assumption that the growth of industries can be represented by an algebraical equation.

I have no doubt Mr. Glenday would freely admit that the representation is only approximate, but I think that the assumption is a dangerous one. There is a fundamental distinction between the empirical functions that we deal with in statistics, and algebraical functions where the form of the functions over an infinite period of past and future is definitely settled by simple algebraical equations. It is vain to look for any formula which will interpret human activities in that way.

In the opening portion of the paper Mr. Glenday compares the human being and the atom. The atom or the electron is assumed by the scientist to have a simplified existence compared with which the abstractions embodied in the economist's economic man are the height of complexity. But the economic man, compared with actual humanity, is such an absurd abstraction that he has become the butt of critics, and has long ago been abandoned by economists.

Every now and then the economists of the present day create a fictitious individual whose habits and preferences differ very widely indeed from the economic man of the nineteenth century, but yet are admitted to be a great simplification of the facts.

When you come to the actual facts, the behaviour of each individual is infinite in its possibilities, and the behaviour of the group is based upon the behaviour of the individuals. One finds every now and then certain broad influences at work, which can be explained by tendencies observable in the individual. But in every case those tendencies are modified by individual propensities which are too complex for us ever to get to the bottom of. We have to do what we can with recorded experience.

What is the application of that to Mr. Glenday's interpretation of recorded experience? I think everyone will agree with his generalization, if it is not made too absolute, that changes, improvements or movements in the economic system tend to operate in the first instance with a rapidity which may amount almost to discontinuity, but that the rate of change tends to diminish. That may be illustrated by any kind of new discovery, whether the invention of a process or of a new industry, or the discovery or opening up of a new territory, or new means of communication. When it is first discovered, there is a rush to take advantage of what is usually a new source of economic rent, like a gas filling a vacuum. When the first rush is over, there follows a period of quieter and more normal growth. That tends to be repeated over and over again. The curves Mr. Glenday has analysed are formed by the super-position of innumerable minor movements. The discontinuities of this type are so numerous that they are smoothed out into curves that have no real relation at all to the **S** shape to which he refers.

The data that he gives us on pp. 537 and 538 do show a tendency for the forms of production to which they refer to display a diminishing rate of increase. But he points out quite frankly that this kind of curve tends to under-estimate the later rate of progress, because it does not give adequate prominence to new industries. It deals with the growing output of old industries, whereas in fact economic growth depends largely upon the output of new industries. Growth might consist in a gradual building up of capital and an economy of labour within given technological limits, a building up of an increased amount of labour-saving capital of known kinds. That is a process which is likely in time to reach a glut, because it is dealing with a limited range of human needs, each of which will ultimately reach a limit of demand. Technological progress, on the other hand, has much wider possibilities. It will economize labour in existing industries, just as the mere growth of capital without such technological progress would do, and the production of increasing quantities of commodities, so cheapened, will reach a limit when the demand is satiated. But technological progress at the same time develops new industries, the products of which would not have found adequate demand under conditions in which economic activity was wholly absorbed in satisfying earlier demands. It is only as labour and productive resources are set free by cost-saving devices in old industries that the new industries can find the increased demand necessary to absorb their products. Therefore there is a perpetual process of growth by which new industries are produced side by side with old ones.

If you have a limited range of human wants to supply, the process of cheapening the production of commodities to satisfy those wants is always tending to come to a limit owing to satiety. On the other hand, if you consider an unlimited range of human wants in relation to a definite human population which is to be equipped with a growing amount of material means of production, it can be enriched almost without limit. It can be enriched by developing new industries and by extending industries, which have originally only supplied the rich, to supply the whole population. As the population is equipped with more and more capital, it is put in the position of adding the equivalent of material hands to its human hands, as if more and more millions of robots were added to the human population, giving it an additional output to satisfy additional wants. That process itself might come to an end. The possibilities of human wants might be exhausted. In that case ultimately the solution might be found, as suggested in the paper, by increased leisure. We may be able to supply all available wants with a small number of hours of work. There is a trend of pessimism in the paper not justified by the facts. The capacity to use human activity usefully is by no means so easily exhausted as Mr. Glenday suggests.

But here I am entering into regions of speculation remote from existing conditions, and in conclusion, all I have to do is to propose a very cordial vote of thanks to Mr. Glenday for his paper.

MR. E. C. RHODES: Mr. Glenday, when replying to the discussion on the Use and Misuse of Economic Statistics before the Society in 1935, confessed that his lead in that discussion was deliberately made "provocative with a view to stimulating discussion." When I read the present paper, my chief reaction was that it would certainly stimulate discussion. This is not the first time that Mr. Glenday has thrown down the gauntlet to the economists. Again he wishes to direct their increasing attention to the study of mass phenomena rather than individual phenomena.

He asks them to regard an economic system as an arrangement of industries and an industry as an arrangement of firms. He recalls to their notice the physicist and chemist interesting themselves more and more in the arrangements of atoms, electrons and molecules. But, at the same time, I believe there are still those who are concerned with the study of the individual unit, just as in biology there is still interest in the study of the individual cell as well as in the patterns of cells.

I am reminded of the impression which may be gained by a distant observer of the peculiar power of absorption by Central London of its teeming millions between the hours of nine and ten each morning (except Sunday), and the equal powers of disgorging this presumably undigested meal between five and six each evening (a conceit, I think, due to Mr. H. G. Wells). It is of interest to such an observer to attempt an analysis of such a situation, mainly to discover the source of the magnetic power of this particular spot. Such researches would lead him to discover the reason in the recorded fact that the streets of the city were paved with gold. Further researches on the reasons why this metal has these powers of attraction would lead to investigations involving individuals among the millions. Perhaps ultimately he would find that the gold was merely a sign, a thing of no real significance. Perhaps the significant facts are that human beings are all the time endeavouring to retain life for as long a period as possible, and those located in and round London have found by arrangements of a mutual character that this object is best achieved by moving themselves in mass to the centre of the city each morning, and performing the reverse process in the evening, after having done certain things in the meanwhile.

I imagine that the philosopher would consider that there was some difference between the case of the human being and that of the electron, or even the living cell, in respect of the arrangement of which each forms part. Besides the economic aspect of such arrangements of human beings there are the political and social aspects. We are concerned here with the economic aspect. There may be danger in attributing too literally a god to the machine. The economic system, if it is to be regarded as an arrangement of industries, must not be considered to have the attribute of vitality. It should be considered rather as a framework. From time to time it is modified, or a new framework is substituted. A reluctance to modify or destroy the framework of society is apt to be shown by those who have grown accustomed to it.

Mr. Glenday feels, as a result of the analysis presented to us, that the present system or framework is perhaps no longer adequate. I used the phrase " the framework of society " just now. My feeling is that the political, the social and the economic frameworks are so tied together that it is really impossible to discuss properly the serious modification of one of them without embarking upon seas which are not marked in the chart, or should I say Charter, of the Royal Statistical Society. He visualizes, I take it, a greater amount of planning in order to maintain the basic long-term pattern of the industrial system. I suppose that will mean similar planning in the political and social systems.

The breakdown in the present system is reached when leisure is preferred to a surfeit of economic production and consumption. It is a debatable point how far leisure has always been preferred by the individual. The proper use of leisure has been the subject of debate from ancient times. Man has been invited to " consider the lilies of the field; they toil not," and warned that " Satan finds work for idle hands to do." Man must work. To what end? To keep the machine of progress alive? To keep the economic system in existence? His conscious effort was to get a sufficient share of the national income to keep himself and his dependants alive from day to day. What his subconscious was concerned with I will not venture to guess, but I doubt if he ever had any subconscious feeling that he must keep the economic system alive.

No doubt, the skilled craftsman had a love for his machine; he delighted to keep it going in proper order. Just as to-day the statistician likes to see his figures arranging themselves in the pattern of a normal curve.

I also doubt if the workman of the past, consciously or unconsciously, was responsible for bringing children into the world because at the age of seven or eight they would be economic assets as coal-miners or chimney-sweeps. After all, even in those days they were liabilities for at least the first year or two of their lives.

With progress in time the individual, by co-operative organization within the economic framework, has been able to get sufficient reward with less effort, and has been able to devote more attention to so-called leisure pursuits, which means that he has more time to spend on the development of himself as an individual as opposed to himself as one of a community. He can now devote more time to the consideration of those arrangements of lines and colours which are called pictures. There may even be a time element involved, when they are called moving pictures. Perhaps the whole object in living after the first needs of survival are satisfied is to have leisure, and what Mr. Glenday calls the breakdown of the framework may be its fulfilment.

Mr. Glenday has certainly made us think.

I am left wondering now whether the economic system keeps us going in order to oil its wheels.

I have much pleasure in seconding this vote of thanks to Mr. Glenday for his stimulating presentation of his point of view.

MR. JULES MENKEN thought that the Society was to be congratulated on the ample philosophical grasp of Mr. Glenday's paper, which was remarkable for a number of reasons. In the first place, it presented the economist with facts which he sometimes disregarded: viz., that human beings and human societies belonged to the material world. and were not abstract creatures operating in the void. Secondly, the paper raised the large question of the fundamental philosophic concepts within whose framework economics and the other social sciences ought to be pursued. As a matter of historical fact, economics was developed by men whose general philosophic background was that of Newtonian physics. The ideas of Newtonian physics required the assumption of a basic atomism which, however useful in physics and chemistry, had proved by experience to be unsuitable as the sole philosophical tool of the sociological sciences. Mr. Glenday's paper, by emphasizing the importance of the idea of arrangement or pattern, as such, brought economics and social science into touch with certain contemporary concepts of physics, chemistry, biology and philosophy. It might well be that the sociological sciences would find their work assisted by the use of this idea of arrangement or pattern, as well as by other concepts drawn from the same sources.

One of the most important points in economic and sociological studies was the question of continuity. Whereas, broadly speaking, the world of physics was a world in which continuities prevailed, in human affairs one of the most striking facts was the existence and importance of discontinuities. During the past week-end events had taken place in Austria which illustrated the fact of discontinuity in economic matters. Even allowing for the fact that a single paper could not discuss all the fundamental ideas relating to long-term economic developments, it was, Mr. Menken thought, unfortunate that Mr. Glenday had not dealt at all with this question of discontinuity.

Against the larger background of Mr. Glenday's paper as a whole, this omission was not perhaps as significant as the fact that the paper made a fresh contribution to the fundamental ideas by which the sociological sciences should pursue their investigations. Mr. Menken hoped that the Society would have more papers conceived with similar imagination and breadth of philosophical grasp.

MR. R. A. MILLS felt in some doubt as to the meaning of " long period " in the heading of the paper. He understood that it might mean sixty years, going by the chart on p. 538. However, on pp. 539–40 references were made to periods of seven or eight years only. Mr. Mills had brought with him a curve of pig-iron production in the United Kingdom over the last seventy years. This showed a distinctly drooping tendency since 1914. A curve of the United Kingdom Industrial Share Index over the same period showed a rising tendency in which $\frac{d^2y}{dx^2}$ appeared to be actually positive. The Industrial Share Index conformed closely to *The Economist* Index of Business over the last seventeen years, so that it might give a moderately accurate picture of the trend of business over the last seventy years. It should not be forgotten, however, that in China the periods of depression and prosperity were reckoned in hundreds of years, so that without the evidence of some essential difference between our economy and that of China the business curve for only seventy years might provide insufficient evidence on which to base " long-period " conclusions. Variety of industry was the essential difference. Mr. Mills said he would like to see an Index of Variety, but so far had only been able to get a very limited, though practical, index in the amount of shelf-space taken up by patent records from 1617 onwards in a subject in which he was particularly interested. So long as variety could go on increasing, he did not think they would see any " long period " falling off in prosperity.

MR. RAMSBOTTOM thought few of those present would dissent from Mr. Glenday's proposition that expansion of an individual industry could not continue indefinitely. It was doubtful, however, whether many would be prepared to accept the pessimistic view taken on p. 545. When dealing with all industries together—*i.e.* with the economic system as a whole—Mr. Glenday said that sooner or later the point would be reached when avenues of new employment could not be provided rapidly enough to absorb at existing wage levels those displaced from both production and consumption, and he likened the situation to that of a body afflicted with cancer. It was not indicated what term of years Mr. Glenday had in mind when he used the phrase "sooner or later," but in view of the continuous expansion of the numbers of workpeople employed in Great Britain over the past fifty or one hundred years, and particularly the remarkable increase in the past fifteen years, it seemed doubtful whether anyone could accept the conclusion—if that were intended—that such a point had yet been reached or that it was within measurable distance.

On p. 522 Mr. Glenday said that "social records point to the existence of a pressure caused by an excess of labour—if we except temporary boom periods—from the year 1873 right up to the Great War." In this connection Mr. Ramsbottom had looked at the available statistics of unemployment and found that throughout the period 1871–1914 the annual unemployment percentage among members of trade unions was over 5 per cent. in only 14 of those 44 years, and less than 4 per cent. in 24 of those years. He would therefore have been inclined to phrase that sentence differently, and to say that there was little evidence of excess of labour apart from certain years of crisis or exceptional depression.

Mr. Glenday also referred to the rise in prices between 1896 and 1913 and said that real wages fell during this period. Mr. Ramsbottom felt doubtful about the use of that statement for the purpose of Mr. Glenday's argument. He doubted whether the reader would realize that prices were falling rapidly during the period from 1880 to 1896, and that thereafter they rose until 1913, when the cost of living was higher than in any year since 1882 or 1883. During almost the whole of that period wage rates were rising substantially. It was doubtful whether it could in fact be said that real wages fell appreciably between 1896 and 1913: such index numbers as existed implied that there was not very much difference between the level of real wages in those two years. The point he wished to emphasize, however, was that this comparison was based on two extreme years, 1896, when prices were at a minimum, and 1913, when prices were at their maximum. If Mr. Glenday had taken 1914 and compared the position in that year with the position a few years prior to 1896, he would have obtained quite different results. He would suggest that Mr. Glenday should insert a note on this point, in order to prevent the reader from thinking that 1896 and 1913 were typical years, and that his argument would be unaffected by choice of other years not far removed from them.

PROFESSOR GREENWOOD said that before calling upon Mr. Glenday to reply to the discussion—and reminding him that an important engagement elsewhere would preclude him from replying orally at length—he would like to add his own views to those of other speakers. He always approached papers on economic subjects with a feeling of awe, and as a working statistician, liked to see some familiar signpost. For this reason pp. 532–3 had cheered him up, although at first he suspected an economic subtlety even here. He recognized in $\frac{d^2y}{dx^2}$ an old friend, but $\frac{dy^2}{dx^2}$ was a stranger.

He dissented from Mr. Hawtrey's view that human phenomena could not be described mathematically. In any case, Mr. Glenday's appeal to mathematics was a modest one. He simply proposed to represent an economic function Y over a short range in time by a function of the form $A \,.\, e^{at^2 + bt + c}$, and that choice implied that he was concerned only with a short-period graduation, since, if t were taken to be sufficiently large, Y must become either zero or infinite.

He was a little surprised that some speakers seem to regard what he would have thought to be a self-evident proposition—viz., that the *group* had characteristics different from those of the *individual*, as false or pessimistic. Dr. Rhodes, for instance, had made merry over the difference between the conclusions drawn by an observer separated from the sphere of activity of the London Transport Board by a few million miles and those of the passengers themselves. They would be different, but not necessarily less important.

Mr. Glenday had not derided the study of individuals; he had simply claimed that the study of groups was quite as important. In preventive medicine the difference between the group and the individual point of view was of fundamental importance. Methods of prophylaxis of individual value might be almost useless from the group point of view. Citizens of Lilliput frequently made friends or even wives of citizens of Blefuscu, although the states of Lilliput and Blefuscu were hateful one to the other. These were surely the merest platitudes. How, then, could the introduction of the group standpoint into economic study be a paradox? Indeed, merely from the narrow standpoint of trading profit, the existence of group wisdom, or folly, was no ground for pessimism. The day was distant when individuals would be well enough educated to resist a herd instinct to buy useless things and to abstain from boring themselves, to the profit of persons expert in the arts of mass psychology.

Mr. Roy Glenday replied as follows: I am most grateful to the Chairman, Professor Greenwood, for the support of his expert authority in regard to the distinction which I draw between secondary or "crowd" laws and primary or "individual" laws. Most of the criticism against my paper by Mr. Hawtrey and Dr. Rhodes falls to the ground because of their inability to grasp this basic distinction. This inability arises, I venture to suggest, from something more than a mere technical misunderstanding. It is due to a fundamental difference in point of view. The liberal economist suffers from an excessive belief in the ruling capacity of the human intellect in relation to the deeper urges and inclinations of man. The idea that a human being can in many respects be regarded simply as an atom, his intellect serving merely as a "technical assistant" in dealing with the emotion and vitality which is in control of human activity, is deeply repugnant to him.

"The liberal individualist," as a recent writer has put it, "believes himself to be emancipated from his organic relation to Society. He has little sense of the organic relation of the individual to the social whole. This lack leaves him without a profound understanding of the inertia of nature which is most clearly revealed in collective human behaviour. He is therefore able to assume that the moral possibilities which his reason is able to envisage are immediately capable of realization in history provided only that a little more reason purifies the reason of others to the degree of purity he feels himself to have attained."*

In my paper I have principally confined myself to those particular "irrational" forces affecting the economic behaviour of human beings which are generated in the process of growth in crowded areas. There is nothing mysterious about these forces. They cover "discontinuities" as well as "continuities."† Mr. Jules Menken puzzles me in this connection when he accuses me of neglecting the former, following this up with the assertion that "the world of physics is a world in which continuities prevail." Here again I think we have a misunderstanding as to what is meant by a "crowd" law. Let me try to explain the matter as simply as possible.

Reduced to its simplest elements, my economic theory might be described as an elaboration of the well-known fact that when, for any reason, a number of individuals coalesce to form a crowd, each automatically loses part of his private freedom to move or act as he pleases. The denser the crowd the greater that loss and the more his personal will and individual freedom of movement become over-ridden and determined by the pressure of the crowd. It is far easier to forecast the movements of a crowd than of an individual, because there are, in the first place, only a relatively small number of ways in which the units of a crowd can be arranged *for any particular purpose*, and in the second place, when movement starts in one part of a crowd, it is liable to set in train a wave which in due time affects to a greater or lesser degree practically every unit in the crowd; so that once a wave is known to have started at one point in a crowd, its future course in other parts of the crowd can often be forecast. As an example of the former we may take the accommodation of a football crowd in a stadium. Given that the purpose is to enable as many people as possible to view the match conveniently, it is clear that the manner in which the seats or other form of accommodation in the stadium can be arranged will be limited; the seating accommodation of practically every football stadium conforms to the same common ground-plan. The more people are accommodated in a given stadium the less freedom of movement and comfort each individual spectator is able to enjoy. For every seating arrangement there will be a limit to the number of people who can be conveniently packed into it. If we try to circumvent this limitation by pulling down the existing stadium and building a newer and larger one, then, since this enlargement of the stadium automatically involves increasing the radius of the circle of seats from the centre of the field, it will mean that though more spectators can now be accommodated in future, this increase will have been secured only at the expense of giving the average spectator a worse view (*i.e.* a more distant view) of the match than in the old stadium. This illustrates a crowd law which may be generalized by saying: that for every structure there will be a most convenient size. The same law will place a limit on our ability to rearrange seating accommodation with the object of giving the pit, say, as good a view as the stalls.

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* Reinhold Niebuhr: *Reflections on the End of an Era.*

† They have been found to operate, so far as I am aware, in every section of the field of natural phenomena in which crowd laws have been investigated. It is for those who object to the application of these crowd laws to human beings to produce evidence, rather than for those who assume that they do apply. It is true that human populations are subject to growth by self-reproduction, a process which has not so far been shown to occur, for example, among the ultimate "particles" of matter. But the failure to observe this phenomenon in the latter case may simply be due to the fact that any adjustments of their "populations" to changes in environment would take place instantaneously, as measured by our time scales. Were it permissible, however, to assume the occurrence in certain circumstances among these ultimate "particles" of a process akin to reproduction, it would surely go a long way to remove the present apparent incompatibility between so-called wave phenomena and quantum behaviour. A human population, as is well known, can behave either as a wave front or as a stream of separate units, according to circumstance.

In my paper I suggest that the above is a more or less precise analogy of the forces at work combating our efforts to raise the standard of living of the masses of people who inhabit our congested towns of to-day, by increasing their money incomes and/or redistributing urban accommodation and amenities.

The dynamic movements of a crowd are subject to similar limitations. Relative movement in one direction in one part of an enclosed crowd will only be possible if there is movement in the contrary direction in some other part of the crowd. (I refer here, of course, to movement *inside* a crowd, and not to that near its boundaries, where different considerations may arise.) A similar limitation will operate even in the cases where the crowd as a whole is in motion, for the existence of a crowd implies that there is a limit to the extent to which any one individual or group of individuals can move in any direction *faster* than the crowd as a whole. It follows from this that relative expansion—unless extremely slow—by a section of a crowd in a particular direction invariably generates an opposing resistance if it proceeds beyond certain limits. Population growth exhibits this clash between growth and resistance to growth very clearly. My paper suggests that similar forces operate to control the long-period growths of industries and economic systems. In the case of industries, for instance, it is this opposition to growth which leads units to combine to form amalgamations and price rings to protect price margins and levels from destruction by internal competitions; or, alternatively, to embark on technological improvements designed to enable goods to be sold more cheaply, thereby overcoming market resistance due to the relatively slow rate of growth of consumers' money incomes, and other causes.

The logistic depicts this process of growth against an increasing resistance under ideal conditions. I do not put forward—indeed, I expressly disavow—the suggestion that we are entitled to expect that data relating to the growth of human populations or of the outputs of their industries should normally be capable of being fitted accurately into the logistic form. But I do submit that these data are capable of analysis in terms of a struggle between forces making for growth and forces opposing growth, of which the logistic may be said to represent an idealized form.

In particular I believe that analysis in these terms throws a new light on the process of industrial growth and evolution and the intermittent fluctuations which accompany it.

For, if I am right in likening the development of our economic system to the struggles of a crowd of individuals striving to occupy a stadium whose structure is altered from time to time in order to accommodate more people, it is not surprising that its growth has been punctuated by discontinuities. To alter or enlarge a structure (especially if this is dependent on the discovery of a new process or invention) will take time, and the result on completion will in any case be to cause a discontinuous "jump" in seating capacity provided. This in its turn will encourage a corresponding discontinuous movement in the flow of the crowd. Since in the stadia of our present economic world we have no means of estimating beforehand either the extent to which any given structural alteration will increase "seating" capacity (*i.e.* the market for goods) or the rate at which the crowd (*i.e.* producers) will move in to fill it, it is not surprising that growth proceeds by an alternation of boom and slump.

So long, however, as economists continue to ignore these "crowd" effects and the pressures to which they give rise, and continue to assume—as they do in their theories—that we still live in a world of more or less perfectly "free" individuals, they must expect their work to continue to be regarded as unhelpful by the practical men of the world of to-day.

Turning to matters of detail, Mr. Hawtrey doubts the value of the figures for population growth given on page 521, on the ground that they take no account of migration. The figures in question as well as those on page 519, are given because they are the only ones available for showing the effect on the total of population growth of the movements shown by the birth-rate curve, and for supporting the view that our population has conformed to the behaviour which Raymond Pearl and many other investigators have shown to be typical of population growth in general.

I do not, however, think that this particular criticism is a serious one. So far as this country is concerned, migration has been prominent in periods, not of congestion, but of relaxation and economic growth. This point was dealt with in my earlier paper (*J.R.S.S.*, Vol. XCV, Pt. I, 1932). As my present paper was already too long, I did not think it necessary to refer to it again specifically here. My point is that despite this increase in emigration the labour market of this country remained congested from 1900 right up to the War. That the effect of migration in any case was small is suggested by the following—admittedly incomplete—data extracted from the *Memoranda, Statistical Tables and Charts* issued by the Board of Trade in 1903, which I have extended to cover the period up to 1914.

It will be seen that, even without subtracting immigrants, the proportion of migrants to total population was quite small. If we could assume that the proportion of immigration to emigration

Population and Migration of the U.K.

Annual Average	Number of Persons proceeding from U.K. to places out of Europe	Proportion of Emigration to Population	Movement of Passengers Inwards
	Numbers	%	Numbers
1855–59	134,304	0·48	Not available
1860–64	127,779	0·44	,,
1865–69	165,283	0·54	,,
1870–74	206,275	0·65	,,
1875–79	124,503	0·37	,,
1880–84	262,441	0·75	,,
1885–89	251,151	0·69	,,
1890–94	202,302	0·53	,,
1895–99	156,114	0·39	,,
1900–04	215,517	0·51	111,789
1905–09	306,971	0·70	146,976
1910–14	416,577	0·91	202,710

was the same for the period as a whole as in the years 1900–14, the only pre-war years for which any figures are available for both, the above percentages should be approximately halved to indicate the *net* effect.

I wish I could share Mr. Hawtrey's optimism regarding our "capacity to use human activity usefully" in the future. As I have given my reasons for dissent at some length in my *Economic Consequences of Progress*, I shall not repeat them here.

I cannot accept the Trade Union percentages of the "aristocracy" of labour, which Mr. Ramsbottom quotes, as providing any adequate measure of the degree of congestion in the employment field as a whole. For the pre-war period for which these figures were collected they represented on the average a sample of certainly less than 3 per cent. of the population engaged in industry. I prefer to appeal to the social records of the period. Besides, if Mr. Ramsbottom will refer to the second series of *Memoranda, Statistical Tables and Charts* issued by the Board of Trade in 1904, in which these percentages first appeared, he will find an express warning against using them for the purpose he has done. As I understand that Dr. Snow intends to expose the statistical weakness of this compilation in some detail at our next meeting, I will not pursue the matter further here.

Mr. Ramsbottom, I confess, surprised me when he challenged my statement that, apart from a shifting of occupation towards the higher-wage groups, there was a fall in real wages in the period 1896–1913. I thought that this was generally accepted. I naturally attach no special virtue to the actual year 1896. It is always difficult to fix the date at which prices or wages are effectively at their minimum. But so far as I am aware, all those who have investigated such scanty information as is available are agreed that, after rising some 40 per cent. in the preceding fifteen years or so, real wages reached some sort of maximum about 1895–96, round which they oscillated till about 1900, after which they fell, apart from the shifting in occupation referred to above. It is with this long-period change that I am concerned in the paragraph from which he quotes. May I refer Mr. Ramsbottom to the latest authoritative book on the subject, published last year by Professor Bowley, and ask him whether he challenges the general statement which is made in it, that there was a significant change in tendency "from generally rising real wages for the greater part of the second half of the nineteenth century to stationariness in the twentieth" ? (p. xiv).

In conclusion, may I stress that my purpose is not to persuade anyone that the point of view put forward in my paper is the correct one, but only to plead that it raises issues of sufficient importance to warrant investigation by those with more leisure, expert technique and knowledge than a harassed business man like myself.

As a result of the ballot taken during the meeting the seven candidates named below were elected Fellows of the Society :—

Alexander Kirkland Cairncross.
H. D. Dickinson.
Shridharrao Yashvantras Durve, B.A.
Albert Edgar Feavearyear, D.Sc. (Econ.).
Khirod Behari Roychowdhury, B.A., B.L.
Hugh Fairfield Smith.
Alix Breillat Turner, B.A.

IS THE TRADE CYCLE A MYTH?

[A Discussion, opened by DR. E. C. SNOW, C.B.E., before the Royal Statistical Society, April 26th, 1938, the PRESIDENT, LORD KENNET OF THE DENE, P.C., G.B.E., D.S.O., D.S.C., in the Chair.]

THE genesis of the suggestion that the Society should this evening discuss some aspects of the subject of "trade cycles" was contained in a paragraph in the paper given by Dr. Isserlis in December. He compared the peaks in the curve for trade fluctuations in general with the corresponding peaks in the curve for tramp-shipping freights, and after pointing out that the agreement was close, added, "A remark that can perhaps be made on Industrial Cycles in general is certainly applicable to the shipping industry:

(1) It is certain that these cycles exist.
(2) Their periodicity—interval from peak to peak—is variable.
(3) Their amplitude is variable.
(4) The position of the peak or of the trough of a cycle in progress is not predictable.

"An *ad hoc* explanation can usually be found for each period of prosperity and for each phase of the cycle if sufficient knowledge is available of the conditions at the time. Thus the high shipping freights of 1873 and 1874 can be accounted for by the demand made on shipping tonnage by France and Germany for the restoration of their disturbed trade after the Franco-German War. The 1900 peak is connected with the demand for shipping caused by the South African War.* It may, of course, be that secular causes are at work which bring such incidents as wars, fluctuations of harvests and fluctuations in the prosperity of shipping and other industries in their train. The fact remains that it is comparatively easy to find explanations for the various stages of a trade cycle that is past, and that it is impossible to predict correctly the occurrence of the successive phases of a cycle which is in progress, and still more so in the case of a cycle that has not yet commenced."

The reason for using a title implying some scepticism about the use of the term "trade cycle" (the word "cycle" in the strict sense implies "regular intervals") is in order to lay stress on the practical aspect of the matters which are involved in discussions on the subject of "trade" fluctuations. I want to try to give a point of view of those who may be called "traders," whose livelihood is bound up with "trading" and who use the word in the dictionary sense—"carried on as a means of livelihood or profit, opposed to 'profession'" (O.E.D.).

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* Mr. Robertson attributes the boom of 1872 to railway building: that of 1882 to inventions in the steel trade: those of 1900 and 1907 to developments in the use of electricity, and that of 1912 to developments in the use of oil power.

The main literature on "trade cycles" is of a theoretical nature, in which the word "trade" is frequently used in a manner not in literal accordance with the dictionary meaning. But there is also a considerable ephemeral literature (in the financial columns of newspapers and journals and occasionally as general news) in which some of the conclusions of the theoretical writers are brought to the attention of those who trade "for a livelihood." The object of the newspaper articles is to provide interesting material for readers, most of whom are concerned in some way or other with "trade." The space for these articles is frequently limited by the editor, and the newspaper reader may receive a very inadequate account of what the text-book writer really said. Writers of financial columns as a rule do not exercise the caution in expression practised by professed economists, and whereas the latter may say "that there is some recognizable degree of regularity in the time sequence and duration of the upward and downward movement" (Keynes, *The General Theory of Employment*), the former say "those with historical minds can point out that the average length of the trade cycle has been eight years."

Small wonder that those whose information on the subject is based solely on what they read in such columns—particularly those with bitter personal experience of unemployment a few years ago, and who have not had the advantage of reading Harrod, Hawtrey, Hayek, Keynes, Macgregor, Pigou, Robertson, Robinson and others—should begin to feel that there may be some inherent property in modern life which will inevitably bring about the return of the sad economic conditions they experienced a few years ago. In making preparations to try to meet the wave which they fear will come in due course and take them off their feet and deprive them of their jobs, they help to spread the very conditions likely to give the wave momentum. It is, to my mind, of particular importance at the present time to re-examine the practical aspects of the "trade cycle" with a view to trying to form a reliable opinion as to the validity of forecasts of the trade future of this country based upon what little knowledge we have of trade fluctuations of the past.

Terminology plays an important part in the matter. "Trade" to most of us is a matter closely concerned with our livelihood, and therefore we are bound to be greatly interested in anything which appears to have bearing upon trade forecasts. Much of the economic literature in this country on the "trade cycle," however, consists of theoretical disquisitions in which the livelihood of those involved in trade, as it is understood by most of us, seems only remotely concerned. It discusses the theory of the economic machine rather than the results which the machine may, when operating under a particular set of circumstances, achieve. The theory of the internal-combustion engine is very important, but it cannot tell us much about the performance of a car in which it may be placed until we know a great deal about many other circumstances of the car. Those who drive the car, however, do not, as a rule, use the same terminology as those who discuss the theory of the engine. Mr. Dennis Robertson in his interesting book on *Banking Policy and the Price Level* wrote, "The practitioners of most sciences are permitted by public opinion to speak to one another in their own jargon: of economists alone it is apparently expected that their conclusions should be expressed in a form which can be understood by the most general reader." Mr. Robertson seems to be inconsistent in his practice. In that book he invented the term (and many similar ones) "spontaneous lacking," which, in his own words, "corresponds pretty well to what is ordinarily thought of as saving." When he had a great opportunity of suggesting the removal of the commonplace word "trade" from the economist's jargon, he deliberately refrained from doing so. Referring to Cassel's *Theory of Social Economy*, he said, "I have substituted 'trade cycles' for the translator's 'conjuncture movements.'" If only he had established the use of the latter term in economic writings, and the economists who have written so freely on the subject of "trade cycles" in recent years had followed him and talked about "conjuncture movements" instead of using the commonplace terms "trade," "boom," "slump," most people concerned with the mundane side of "trade" would have appreciated that the discussions of the economists had no bearing upon the subject of their livelihood. Public interest in the National Savings Association would hardly have been maintained had it changed its title to "The National Association for Spontaneous Lacking." Similarly, few traders would have worried themselves about the discussions which have taken place under the title "trade cycles" if these had, in fact, been termed "conjuncture movements."

In the ephemeral literature, it is frequently assumed that the more serious studies have demonstrated that the "Trade Cycle" has a fairly constant period, and accordingly that it can be used for making approximate forecasts of the future. The actual figures mentioned vary with the writer—seven or eleven years, or some other period—and many people have looked upon 1938 as a year of ill omen because it happens to be seven years after the disastrous year of 1931.

I have nowhere seen in the writings of the economists any definite statement that theory leads to the conclusion that the " trade cycle " is of approximately uniform period, though some of them appear to get close to it. Mr. Keynes says, " We do not, however, merely mean by a *cyclical* movement that upward and downward tendencies, once started, do not persist for ever in the same duration, but are ultimately reversed. We mean also that there is *some reasonable degree of regularity in the time sequence and duration of the upward and downward movements*." (My italics.) Professor Pigou says, " There is not, indeed, uniformity in respect either of period or of amplitude among successive industrial movements, *but a distinct approach to regularity*." (My italics.) The distinguished economist who is responsible for the latest feature in periodic economic literature (and I am sure that many Fellows of the Society will welcome the publication of the *Economic Bulletin* by the Chartered Accountants) makes some wide (and, I think, unproven) claims, but does not stipulate uniformity of the upward and downward movements. In the first issue of that *Bulletin*, talking of industrial fluctuations and under the heading " Length and Amplitude of Cycles," he writes, " It follows from what has been said that, over a long period of years, the average length of the cycle is the same in all industries. If there were exceptions there would come a time when the boom in some industries would occur during a period of general industrial depression. Again, if the average length of the cycle varied from industry to industry *there would be no such general cyclical movement as is known to have existed for over a century*. (My italics.) The existence of such a movement is itself sufficient evidence to show the ultimate interdependence of industries. . . . Although over a long period, the average length of the cycle is the same in all industries it does not follow that in a single industry the length is the same in each and every cycle." Though there is a good deal in this quoted statement which seems to suggest that Professor Jones holds definite views regarding the existence of some regularity of association between movements in different industries, it cannot be taken as supporting the view that there is a constant period in general trade fluctuations.

The only direct *primary* statistical material bearing upon the subject of the regularity of industrial fluctuations in this country is based upon certain figures of unemployment from 1860 to 1914. Data of a nature almost perfect for the purpose of statistical analysis for the detection of " periodicity " have been published by the Ministry of Labour for the past fifteen years in connection with Unemployment Insurance, while figures which will in due course be useful for a similar purpose, relating to quarterly indices of industrial production, have been published by the Board of Trade for ten years. Neither of these series, however, has yet been collected over a long enough time to be of use for the discovery of post-war "periodicities." Certain other data are available for the five or six decades before the War—overseas trade figures, prices, etc.—but these are of the character termed by Professor Macgregor as "secondary," and by their nature they cannot provide *direct* evidence of the periodicity of industrial fluctuations in this country. Much has been written about the use of the unemployment data of the nineteenth century and the light they throw upon the trade cycle. Professor Pigou reproduces them in his book and sets them out in charts. They were first published in the second series of *Memoranda, Statistical Tables and Charts* by the Board of Trade in 1904, and have been copied by various writers from that volume, while they have been brought up to the outbreak of the War in 1914 in the *Annual Abstract of Labour Statistics.* Professor Pigou summarizes the lessons of the curve in his chart as follows: "The chart displays a clearly marked rhythmic or wave-like succession of fluctuations. The waves are not of equal length nor yet of equal amplitude. As regards length, the figures yield the following results. From 1860 till 1914 the intervals between successive years of minimum unemployment are 7, 10, 7, 10, 7, 7 and 5 years respectively; the intervals between successive maxima 6, 11, 7, 7, 11 and 4 or 5 years respectively; the average length of periods of lessening employment being $\frac{26}{6}$ years and that of periods of improving employment $\frac{21}{6}$ years. . . . The general movement is thus rhythmic. . . . The successive cycles are broadly similar to one another. A 'typical' cycle constructed by making, as it were, a composite photograph of all the recorded cycles would not differ in form very widely from any of them. Its duration from minimum to minimum would be $7\frac{4}{7}$ years . . . but this typical cycle is not an exact replica of any individual cycle. The rhythm is rough and imperfect. All the recorded cycles are members of the same family, but among them there are no twins." Inspection of the diagram in Professor Pigou's book shows that at certain of the troughs in the chart the lowest point differs so little from the one next to it that the fourth, fifth and sixth figures in the first sequence printed above might with almost equal reason be 11, 6, 8, instead of 10, 7, 7. When we appreciate how extremely deficient the data are as a true representation of the industrial circumstances the period covered, we must acknowledge that Professor Pigou's sequence—7, 10, 7, 10, 7, 7, 5—for a sample of the population which, as I show below, hardly deserves to be dignified with the statistical term "sample," may be quite consistent with the true figures for the *whole* industrial population being 7, 10, 6, 11, 6, 8, 5. In my opinion, the data of unemployment from 1860 to 1914 do not afford proof, or even evidence, of regularity of periods of *general* industrial activity. They appear to me to be quite consistent with lack of regularity. They disclose that there were seven main fluctuations, and the data are not inconsistent with the view that for *general* industrial fluctuations any one of the periodicities 5, 6, 7, 8, 9, 10 or 11 years is equally likely. If seven cards with these seven numbers were put into a hat, and a number drawn on seven occasions there would be nothing remarkable in having one number drawn twice—or even thrice. In other words, even if the circumstances of the present time were similar to those of 1860–1914 (and in some very important respects they are quite different) all that we are really justified in saying at the beginning of a trade fluctuation is that it may be 5 years, or it may be 6 years, or 7 years, or 8 years, or 9 years, or 10 years, or 11 years, and no one figure is more likely than any other.

The writers of the Board of Trade Memorandum appear to have been fully aware of the inadequacy of the data and provided many words of caution. "It is to be remembered that we are now concerned with *comparative* figures and tendencies only. It is not suggested that when 5 per cent. of trade union members are returned as unemployed we are at liberty to conclude that just 5 per cent. of the whole working population of the United Kingdom are out of work. For, among other considerations, the groups of trades which include the great bulk of members of trade unions which insure their members against want of work are probably the groups of trades in which the liability to fluctuations is above the average of skilled occupations as a whole. Thus the engineering, metal and shipbuilding group, which are notoriously fluctuating industries, are over-represented in the trade union statistics of unemployed, while such comparatively stable industries as agriculture and railway service are scarcely represented at all. On the other hand, unskilled casual labour is insufficiently represented in the returns, which mainly apply to skilled workmen. Thus for some reasons the percentage returned is likely to be greater, and for other reasons less, than the real average percentage unemployed throughout the country. For the above reasons it is not safe to conclude that the actual percentage returned as unemployed by trade unions at a given date is equal to the percentage unemployed in the whole industrial population at the same time. For the purpose, however, of making comparisons and showing tendencies over a period of years, the percentage returned as unemployed by trade unions in particular groups of trades is the safest figure on which to rely, and the average percentage for all the groups of trades represented in the returns may be appropriately used for the same purpose, provided that the trade distribution of the members of the unions included has not very materially altered during the period over which the comparison extends, and that the more important unions represented correspond throughout."

Without going to original sources this quotation from the Board of Trade Memorandum provides quite sufficient words of caution to show how unjustified generalization from the data really is. An examination of the original Trade Union reports which provided the crude raw material on which the Board of Trade memorandum was based, however, shows that the caution should have been expressed in much stronger terms and justifies the view that rarely, if ever, can conclusions of such far-reaching importance have been drawn from such statistically weak foundations.

Now that we have such admirable information regarding unemployment regularly published by the Ministry of Labour and of industrial production published by the Board of Trade, it is important to emphasize that the pre-war data on which the evidence regarding the length of "trade cycles" in this country is based, were of an entirely different character. They happen to be the only ones available having any bearing whatever upon the subject of employment over an extended period, but, compared with those now being regularly compiled, they appear almost like the speculations on what the birth rate in this country was before registration was introduced compared with the accurate figures of the present day. The work of compiling the Board of Trade Memorandum involved analyses of Trade Union records going back to the middle of last century. The fathers of the Trade Union movement, through whose exertions they became available, could not have dreamt that the figures they laboriously compiled were likely to be used in the 1930's for forecasting a few years ahead the state of employment in this country, and in view of the great weight which is now being put upon this statistical edifice it is worth while spending a little time in examining its foundations. In the appendix, I have set out a few points which have occurred to me in reading through some of the original Trade Union reports.

Perhaps this is an appropriate place to say a few words about the parts played by statistical analysis and economic theory in throwing light on industrial fluctuations. It should not be necessary in this place to stand up in defence of statistical analysis, but in view of remarks of economists on the matter it may be desirable to do so. The lauding of theory and belittling of statistical investigation is not uncommon among economists and perhaps the best way of bringing to the attention of statisticians the views of economists will be by quoting a few extracts from Professor von Hayek, who though Tooke Professor of Economic Science and Statistics in the University of London approaches the subject, it seems to me, entirely from the theoretical side. This I do in a footnote below.*

It is not for one who is the merest tyro in economic theory to express a judgment on the importance of theory in throwing light on industrial fluctuations, but many of the exponents of economic theory give me the impression that they are no better equipped for judging of the utility of the statistical tool, and therefore I can no more accept them as competent to hold the scales between theory and statistical research than I, or anybody else, can accept myself as competent. But speaking from one side of the fence, this seems to me to be a suitable place to express surprise at the very small extent to which statistical tools are employed by economists. In many other directions—as is evidenced by the variety of the papers handled by the Agricultural and Industrial Research Section of the Society—statistical equipment is becoming more and more employed, and nobody would dream of doubting its utility in those directions. The nature of the data in economics is such that facility in the use of statistical tools seems to me to be almost a *sine quâ non* of success. This is not to under-rate the importance of the part to be played by theory. But theory in economics is something different from theory in chemistry or physics, inasmuch as fundamental facts are constantly changing. A theory which may have been satisfactory when the bulk of the world was on the Gold Standard and there were no such things as exchange controls, import quotas, regulation of production, etc., may be quite hopeless now, and one which may fit the conditions of to-day may be equally hopeless to-morrow. Physical and chemical phenomena can be readily explained by theories because the elements they deal with are invariable. The reason, as it seems to me, why economic phenomena cannot be readily explained by theories is that the elements dealt with are extremely variable. A new theory would be required every day to keep pace with the changes which occur in the modern economic world. But while economic elements may be becoming more variable, economic data are becoming more reliable and new statistical methods are being developed. Many economists seem determined to carry on their work without mastering the use of these methods, and a good example of the sterility which is caused through that attitude is afforded by Professor Macgregor's essay on "Enterprise and the Trade Cycle" (see *J.R.S.S.*, Pt. I, 1935, p. 168). Even with advancing years I have never been able to get rid of the conviction that an hour of arithmetic may be of greater utility in forming reliable impressions on economic affairs than twenty hours of talk. "Analytical economists," Mrs. Wootton has recently remarked, "are distinguished not so much by their interest in, and attention to, phenomena, as their indifference to, if not their contempt for, many of the laborious observations undertaken by some of their more worldly colleagues. . . . The suggestion that concrete observation is fruitful in anything like the same sense as analytical speculation is apt to be indignantly rebuffed." I acknowledge myself to be 100 per cent. for "laborious observation." This is not the place to dwell on the matter of method, but it seems to me that such views as those of Professor Jones which I have quoted—"that the average length of the cycle is the same for all industries"—should, before any further superstructure is built upon them, be subjected to analysis by "laborious observation." To do this thoroughly we would require such data as have been collected by the Ministry of Labour over the past 15 years continued for a much longer period. But the figures of 15 years only are not without value for this purpose. If there really were "cycles of trade" in which the length of the cycle was the same for all industries, we should expect a good deal of uniformity in the correlations between movements of unemployment in different industries even over a period of 15 years. In actual fact the correlations vary widely.

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* "Empirical studies . . . can at best afford merely a verification of existing theories; they cannot in themselves provide new insight into the causes or the necessity of the Trade Cycle" (p. 27).

"Just as no statistical investigation can prove that a given change in demand must necessarily be followed by a certain change in price, so no statistical method can explain why all economic phenomena present that regular wave-like appearance which we observe in trade-cyclical fluctuations" (p. 30).

"The statistical approach, unlike the deductive inference, leaves the conditions under which established economic relations hold good fundamentally undetermined; and similarly the objects to which they relate cannot be determined as unequivocally as by theory. Empirically established relations between various economic phenomena continue to present a problem to theory until the necessity for their interconnections can be determined independently of any statistical evidence" (p. 31).

"The corroboration of statistical evidence provides in itself no proof of correctness. *A priori* we cannot expect from statistics any more than the stimulus provided by the indication of new problems" (p. 31).

". . . There can be no doubt that trade-cycle theory can only gain full practical importance through exact measurement of the actual course of the phenomena which it describes. But before we can examine the question of the true importance of statistics to theory, it must be clearly recognized that the use of statistics can never consist in a deepening of our theoretical insight."

"Though nearly all current trade cycle theories use statistical material as corroboration, it is only where the given theory fails to explain all the observed phenomena that this statistical evidence can be used to judge its merits."

"The dependence of statistical research on existing theoretical explanation hardly needs further emphasis. This holds good not only as regards the practical utilization of its results, but also in the course of its working, in which it must look to theory for guidance in selecting and delimiting the phenomena to be investigated. The assertion that statistical investigation of the trade cycle should be undertaken without any theoretical approach is, therefore, always based on self-deception. On the whole, one can say without exaggeration that the practical value of statistical research depends primarily upon the soundness of the theoretical conceptions on which it is based."

But I have exhausted my time, and I suppose I should try to give a short answer to the question asked in the title. My view is that to those who use the words "trade" and "cycle" as the dictionary would have us use them, and as the bulk of people do use them, the "trade cycle" is a myth. For those who give different meanings to the words and who have introduced concepts into the term "trade cycle" (for example, "the fundamental feature of the upward swing of a trade cycle is a large and discontinuous increase in the demand for 'short lacking'") unintelligible to the common man, I am unable to speak. "But the question is," to quote Alice, "*can* words be made to have such different meanings?"

APPENDIX

Some Notes on the Trade Union Data used in compiling the index of Unemployment 1860–1914

(1) On the question of the magnitude of the sample represented by the Trade Union reports the following are some relevant figures:

According to the Board of Trade Memoranda the membership of the sixteen Trade Unions on which the index number of unemployment was based was 129,309 in 1881. The total number of people occupied in England and Wales in 1881, excluding the 1,477,000 in agriculture, was 7,374,000. The Trade Unionists, therefore, represented 1·8 per cent. of the total occupied population (other than in agriculture) over ten years of age. In 1901 the corresponding proportion was 2·9 per cent. Going back to 1860, it would appear that the size of the sample was considerably less than 1 per cent. On the average over the period we are probably over-stating the size of the sample by calling it 2 per cent. of the population engaged in industry.

(2) On the question of the constitution of the sample, and whether it can be considered as a random one, drawn in equal proportions from the various constituent parts of the total population, it is clear from the detailed figures in the Trade Union reports that engineering, shipbuilding and metal industries constituted, over a considerable part of the period covered, the bulk of the Trade Unionists providing figures of unemployment. These groups of "engineering trades" were considered by the authors of the Board of Trade Memoranda to constitute three-quarters of the total of the sample over the period 1860–70, three-fifths over the period 1870–80,

rather less than three-fifths between 1880 and 1890, and in the next ten years about two-fifths. At the census of 1881 those employed in the engineering trades ("Metals, Machines, Implements and Conveyances") constituted 12 per cent. of the total males occupied over 10 years of age (excluding those in agriculture). In 1891 the percentage was also 12, and in 1901 it was 13. It is quite clear, therefore, that the sample was unduly weighted by these engineering industries, and that it was very far from being a random sample of the industrial population of this country. The Board of Trade Report stated that "the fact that employment in the engineering, shipbuilding and metal trades fluctuated more violently than in industry as a whole, though in the same direction, is not difficult to explain, when it is remembered that the group of trades is largely concerned with the making of the instruments of production—machinery, implements, ships, engines, etc., and other forms of fixed capital—and that a very small expansion or contraction in the total output of commodities in the country is likely to cause a relatively large expansion or contraction in the demand for new instruments. Thus this group of trades affords a very sensitive, though exaggerated, indication of the changes in the labour market as a whole. It becomes clear, however, that before drawing any inferences from the figures showing the course of employment in all trades included in the returns, it is necessary to consider whether the proportion in which the strongly fluctuating engineering, shipbuilding and metal group is represented in the total has very materially changed during the period covered by the tables and charts, and if requisite to make proper allowance for such change. . . . The result of this gradual change is to exaggerate the apparent fluctuations of employment in the earlier years of the series as compared with the later, and to give the impression that employment is now (1903) more regular and stable than in the earlier years in which the statistics were dominated by the more fluctuating group of trades. To avoid this cause of error a corrected series of percentages has been calculated, giving the same weight throughout the whole period to the engineering, shipbuilding and metal group. Thus the corrected general percentage of unemployed is the unweighted mean of the percentages for the two groups—'engineering, shipbuilding, and metal trades,' and 'all other trades'."

The Memoranda published two indices, one termed "uncorrected" and the other "with corrected weights" based upon the method indicated above. The series which Professor Pigou uses in his book was that published in table A of the Report (page 90) marked "uncorrected." The corrected index differs appreciably from that used by Professor Pigou. I am not prepared to say that one series is any better than the other for the purpose of representing the general state of unemployment in the whole of industry during the period covered by the groups, as each is so bad a sample of the whole that discussion on which is the better is idle. It may be mentioned, however, that if the "corrected" series had been used, the sequence of figures given above from Professor Pigou's book would have been 5, 7, 10, 8, 6, 3. The curve would be somewhat flatter, and instead of the last long period of ten years two periods of 6 and 3 respectively would have appeared.

(3) At the head of the table in Professor Pigou's book in which he reproduces the figures from the Board of Trade Memoranda it is stated that persons on strike or lockout are excluded. The table in the Memoranda itself does not contain a similar note, though the text makes reference to "loss of time through sickness, holidays, strikes or unpunctuality." Going back to the original returns of the Trade Unions, it is not clear that the figures could be rectified throughout by the exclusion of those on strike or locked out. I am not at all sure that strike pay was excluded from the figures of unemployment pay in the early years, though certainly the figures relating to the period after 1903 were suitably corrected. It was relatively easy to separate strike pay from total unemployment payment when the collection of the statistics was a routine part of current work, but a different matter entirely when collating those which had been put together by Trade Union officials forty years earlier with no regard to statistical requirements. It would burden this note too much by going into detail on this point, but reference to the original returns of the Trade Unions will be found interesting to those who want to delve deeper into the subject.

(4) The published figures indicate 1852 as a year with a high rate of unemployment. This conclusion was based upon the fact that a relatively large amount of money was paid out in unemployment benefit in the engineering trade. It is stated in the Union report that the heavy expenditure of that year was occasioned by a lockout of nearly the whole trade. Unemployment benefit, which had been £5111 in 1851, went up to £46,670 in 1852, but was back to £2622 in 1853. It is further stated in the report of the Engineers' Union that between 1875 and 1880 the funds of the Society were considerably reduced as the result of numerous disputes which took place through strikes, which were frequently in respect of attempts by employers to reduce wages and increase the hours of labour. The unemployment benefit, which had been £21,000 in 1874, went up to £32,000 in 1875, and then to £45,000, £54,000, £76,000, £150,000 (in 1879), £62,000, £40,000 and back to a normal figure of £23,000 in 1883. It looks as if these "frequent attempts by employers to

reduce wages and increase the hours of labour" contributed towards the peak shown in the curve for 1879.

(5) The level of unemployment in the building trade (one of the industries providing material for the Board of Trade index of unemployment) was much lower than in the engineering trade over practically the whole of the period covered by the curve. When we remember that even at the height of the building boom in 1935, 1936 and 1937 the lowest monthly percentage of unemployment given by the very comprehensive figures of the Ministry of Labour) in the building trade was 10·4, it is astonishing to read that the rate of unemployment in the 'seventies and 'eighties of last century was of the order of 1 or 2 per cent. This is partly explained, however, by the fact that under the Trade Union rule a member could only receive a maximum of £9 12*s*. in unemployment benefit in one year. In the Engineering Society the benefit was continuous as long as the man remained out of work, and he might receive as much as £19 10*s*. in a year. This rule of the Builders' Trade Union must have had quite an important bearing upon the figures of unemployment of the period.

(6) The percentage of unemployment in the building trade was particularly low over the years during which the membership was rapidly increasing. The membership advanced from 600 in 1860 to 8000 in 1866, and the unemployment over that period was stated to be less than 1 per cent. The membership then increased slowly to 9800 in 1871 and unemployment went up to 3 or 4 per cent.: then in the next five years the membership increased rapidly to 16,000 in 1876 and the unemployment figure was round about 1 per cent. during the period. Whatever the true intensity of unemployment, we should expect that during a period of rapid growth of a Union the proportion of members receiving unemployment pay would tend to decrease, because the large number of new members would naturally all be employed. For purely statistical reasons, in periods of rapid growth of membership the percentage unemployment would tend downwards. The same indication, though not so marked, appears in the figures of the Amalgamated Society of Engineers. It is not possible to say to what extent the decline in the percentage of unemployment was due to more trade and to what extent it was due to the purely statistical reason of taking in new members at a rapid rate.

The Trade Unions of the time probably deserved the title "aristocracy of labour." The likelihood of unemployment among the unionists was probably less than among non-unionists. To some extent the Trade Unions performed the function of an employment exchange in helping their members to get employment, and in the report of the United Patten-Makers' Association for 1877 it was stated that "there was a reduction in the average number of our members idle which was attributable to increased vigilance on the part of our branch secretaries and members generally in securing for our members every possible vacancy." In the industries where the Trade Unions were strong, the members of the Union had probably a better opportunity of getting any jobs available than did non-Unionists.

DISCUSSION ON THE TRADE CYCLE

PROFESSOR VON HAYEK: Coming into town to-day by an unaccustomed route, I saw a notice-board displaying the word, "Trade cycles repaired." But in spite of this curious omen, I do not propose to do here anything of the kind. I am, in fact, to some considerable extent in agreement with Dr. Snow's critical remarks, at any rate in so far as they were directed against the suggestion of a definite periodicity implied by the word "cycle." It is probably true that in everyday usage the term has such an implication. But I doubt whether many economists nowadays intend to suggest anything of the sort, and some of the more careful have made it quite clear that they do not. In the United States, where such problems seem to be treated with particular thoroughness, a conference of representatives of different scientific disciplines, especially called for the purpose, has decided that the term "cycle" does not imply periodicity, but merely the recurrence of similar phases in a regular order or time-sequence. And in Professor W. C. Mitchell's well-known work on *Business Cycles* a whole section is devoted to safeguarding against any interpretation of the word cycle as suggesting recurrence at fixed intervals.

In some respects, however, I am prepared to go even further than Dr. Snow. It seems to me by no means certain that even in this more general sense we are entitled to speak about *the* trade cycle. This suggests that all or most of the ups and downs of trade which we observe are manifestations of one single phenomenon, caused by a distinct set of circumstances, and therefore to be explained by some single theory. It must be admitted that probably the majority of economists, or at any rate a great many, believe in the existence of a trade cycle in this sense. Although I am not guiltless in this respect, I feel now more and more that there is reason for a good deal of scepticism. There are, of course, certain typical theoretical problems raised by any attempt to explain a particular crisis or depression, problems on the solution of which economists sometimes agree and perhaps more often disagree. But the question is whether it is legitimate to fit the different theorems by which these questions are answered, into one single scheme for which it can be claimed that it will explain all or most industrial fluctuations. The question what will be the effects of an increase in the monetary demand for consumers' goods, or of a reduction of the rate of interest at which money can be borrowed for investment purposes, or of inventions, are legitimate theoretical problems. But whether these various causes which influence industrial fluctuations always combine in such a regular manner as to produce a distinct and uniform phenomenon which can be accounted for by some single theory must appear somewhat doubtful.

It is, however, by no means clear that it is the economic theorists who have mainly sinned in this direction. It seems as if the statisticians, or at any rate the statistically minded economists, would tend to be particularly dogmatic in this connection. What else do the persistent attempts to find common characteristics of all trade cycles by some method of averaging and the like mean but that it is uncritically assumed that they must possess marked similarities which will enable us to construct some typical or standard pattern of *the* trade cycle? I am inclined to suggest that this dogmatism of many statistical economists is the main reason why the statistical study of the industrial fluctuation has so far borne comparatively insignificant fruits. Perhaps these efforts would be better spent if, instead of a vain search after the common characteristics of all cycles, we tried to provide really careful historical accounts of the course of events preceding and following particular crises, and then investigated how far our theoretical knowledge enabled us to explain these events. The theoreticians would then have an opportunity to test their views about particular problems of the theory of money or capital by applying them to these particular situations. But, to repeat, whether beyond this there is scope for a separate theory of *the* trade cycle must for the time being remain at least doubtful.

There may be reasons to expect that in particular circumstances, particularly under the existence of the pre-war type of gold standard, industrial fluctuations may show a greater degree of regularity than at other times. But as Mr. Hawtrey, who has made this problem his special study, is with us to-night, I need say no more on this subject. I would rather use the remaining minutes to comment briefly on what Dr. Snow said on the contributions statistics and economic theory respectively have made, or can make, to our understanding of industrial fluctuations. I am afraid that here I am still unrepentant, and still doubt whether statistics can do more than on the one hand to raise questions which the economist must try to answer, and on the other hand to show whether the effects economic theory leads us to expect do or do not appear. I do not think this is in any way to belittle the rôle of statistics. It means really no more than that a search for " facts " will lead nowhere unless we have some initial idea what facts we regard as relevant—a point on which I should have thought there could not be much disagreement.

As an instance of how misleading exclusive reliance on statistics may be, I should like to refer to the celebrated economist and protagonist of empirical research whose name is associated with my academic title, Thomas Tooke. He showed—and there can be little doubt about the fact—that low rates of interest usually coincide with falling prices, and high interest rates with rising prices, and concluded from this that the Ricardian idea, that a reduction in the rate of interest would lead to a rise of prices and *vice versa,* was wrong. I doubt whether there is to-day a single economist of repute who would be willing to assert for this reason, with Tooke, that a low interest rate leads to a fall in prices or the contrary. I need hardly waste time to explain the paradox—but statistical research has not helped us in any way to solve the difficulty.

There is one little point on which I should like to add a few words. Dr. Snow quoted a statement intended to prove that the average length of the cycles in the different industries is the same, and seemed even to give it his approval. If I understand the argument rightly, it seems to me, however, to be based on a fallacy. It is argued that unless the average length of the interval between successive crises were the same in the different industries, "there would come a time when the boom in some industries would occur during a period of general industrial depression." Now, it has by no means been unknown that a particular industry did not take part in a boom or a depression which was fairly general in the other industries. And it is by no means unlikely that a careful study of the fluctuations of *e.g.* the textile industries would reveal that the "cycles" there were considerably shorter than in, say, the constructional industries. This need not mean that these two groups of industries would get permanently out of step. If during a particular historical phase two "cycles" of the one group of industries fitted into one "cycle" of the other, we should at the end of the major period still have a really general depression, and might even get a quite regular recurrence of such depressions without any equality in the lengths of the "cycles" in individual industries.

MR. R. G. HAWTREY : Dr. Snow's case really was based upon the argument that a cycle means a recurrence of a period of uniform length, and that the period of the so-called "trade cycle" is very variable. Like Professor von Hayek, I do not think that an exactly uniform period is an essential characteristic of a cycle. There are many kinds of cycles, and they have different characteristics. Some, for example, are linked up with astronomical phenomena. No cycle could have greater exactitude than the rotation of a planet or the earth, and there are cycles in human affairs which have an astronomical basis. A man shaves every twenty-four hours. The precise time of his shaving may vary slightly from day to day, but if he deviates a little from his usual hour one day, it does not affect the hour at which he shaves the next day. On the other hand, the cutting of a man's hair is also periodical, but if for any reason he hastens or postpones the visit to the barber on one occasion, it does affect the subsequent dates, because he starts afresh in the next period, and uses his judgment as to when his hair needs cutting again, without regard to the length of the preceding interval.

That does not exhaust the types of cycle. Anyone who has watched an hour-glass will have observed that the slender stream of sand which falls down makes a little conical heap in the lower part of the hour-glass. The cone is built up higher and higher, until it suddenly becomes unstable and collapses, and then another cone begins to be built up. The interval may be anything from, say, a second to ten seconds. There you get a purely physical phenomenon which by quite fortuitous circumstances has a recurrent character, but at a very variable interval. A somewhat similar phenomenon, subject to human control, is to be observed when a cargo of coal is being shipped in the hold of a steamer. A cone is built up as the coal is dropped in, and then at a certain moment the proceedings are stopped and men go on board to trim the cargo and distribute it over a flat surface. That is a "managed cycle," and it depends, like the cutting of our hair, to some extent on human judgment.

In the case of the trade cycle there is a stream of money instead of coal or sand, and a very complicated human agency engaged in distributing it. The period occupied between one moment of instability and the next depends upon human behaviour. It is not surprising, therefore, that the interval should vary a good deal. I speak of a stream of money, and some years ago I perpetrated the remark that the trade cycle is a purely monetary phenomenon. This excited a certain amount of fury among my fellow-economists, but I observe that nobody nowadays can write a book about money without introducing the trade cycle and the theory of deflation and depression, and no one can write about the trade cycle without giving a large proportion of the space to money. Everyone agrees that the process by which the trade cycle is regulated is very much affected by a number of events which are not primarily monetary in character. That goes without saying, but I think that it is an established fact that the central characteristic of the trade cycle is an expansion and contraction of what may either be called the total income or the total demand for commodities in terms of money.

Dr. Snow concentrated on the unemployment percentage of Trade Unions, as if that were the primary statistical basis of trade-cycle theory. That, I think, is a mistake. Certainly when I approached the subject of the trade cycle in my youth it was not primarily the Trade Union percentage that I judged it by: I was interested in the Foreign Trade Returns and their connection with the price level. Unemployment came in as an afterthought, but foreign trade, price level and unemployment are only a few among innumerable indicators. Every section of economic life is affected by the trade cycle, and in trying to estimate the period of the trade cycle as it was from 1860 to 1914, it is found that all these different indicators record approximately the same general fluctuations.

I entirely agree with Dr. Snow that it is impossible to identify a particular moment as the turning-point, either as maximum or minimum; that is not involved in the theory at all. What is essential is that there is this simultaneous march of data all in the direction of activity at one time, and in the direction of depression at another. As a matter of fact, I think that even in the nineteenth century the trade cycle was actually less uniform than the statistics of Dr. Snow would seem to suggest. For example, a thing that is always slurred over in historical accounts of the trade cycle is that there was a depression in the years 1861–63, a period of activity in 1857; a severe depression in 1858; a high degree of activity again in

1860; a depression again in 1861–63 and a high degree of activity in 1864–66. That cuts up the trade cycle in a way that is not usually recognized, but I think the statistical evidence for it is perfectly clear. There is nothing inconsistent with the monetary theory of the trade cycle in there being a cycle of three years, or in there being a cycle of eleven years.

What I have been saying has referred to the pre-war trade cycle, and I should say that in the sense in which there was a trade cycle in the nineteenth century, there has been no trade cycle since the War. For one thing, the international movement, though it has not been entirely absent, has by no means had the general uniformity that it had in the nineteenth century.

On taking the country from which the trade cycle is usually illustrated nowadays—the United States—a quite clear alternation will be found from 1920 to 1923. There was a reversion in 1923 to a degree of activity corresponding to that reached in the spring of 1920, so that a complete cycle was accomplished in three years. But since 1923 there has been a cycle which is now uncompleted. There was a period of activity, broken undoubtedly with small fluctuations from 1923 to 1929, and then a period of depression with tentative moves towards revival, but nothing that can be called a complete revival, from 1930 to 1938, and, so far as we can foresee, the " cycle " may be completed in eighteen months or in eighteen years from now. There is nothing cyclical at all: all trace of the approximate uniformity of the nineteenth century has been completely lost.

It would be possible to pursue the subject in the statistics of other countries, and I believe that the departure from cyclical periodicity would be found to be even more evident.

Dr. Snow criticized the use of the Trade Union percentage as not being sufficiently representative even within its own limits. But if the Trade Union percentage is compared with the unemployment insurance statistics for the period in which they are both available, that comparison tends to confirm the value of the Trade Union statistics. To start with, the unemployment insurance statistics cover a limited field, not so very different from that of the Trade Union statistics, and they correspond very fairly closely, the insurance statistics yielding a somewhat higher percentage (perhaps by 1 per cent.) than the Trade Union statistics.

After the War for a short period there were the Trade Union statistics concurrent with the extended unemployment insurance statistics, and there was an equally close correspondence, or even a little closer. Then, again, a comparison can be made of the industries insured against unemployment in 1911 with the total of industries insured in the period from 1920 to the present time, and there quite a fair approximation will be found. The selection insured in 1911 turned out to be not at all a bad sample of the whole of industry.

I would not press that argument too far: I recognize, for one thing, that the Trade Union sample was rather smaller in the earlier years, and I recognize also the criticisms that Dr. Snow passed upon it on certain technical statistical grounds. I do not think that these criticisms seriously impair the value of the figures. Particularly when examining the trend of employment between one year and the next, or between a year, or two or three years, before, and afterwards, I think it is legitimate to build a good deal on the Trade Unions percentage. But it is a mistake to base the whole theory exclusively on that percentage. Rather its true bases is the enormous mass of statistics, all confirming one another, in the period before the War.

Was not Dr. Snow rather unjust to the economists of the present day in suggesting that they did not take sufficient account of statistical material? There may be a number of economists who prefer to concentrate on theory, and I dare say some of them build up their theories too high without examining the statistical foundation. But of course the construction of new and original theories itself helps to make the examination of the statistical material fruitful. As Professor von Hayek has insisted, it is essential to accompany statistical investigation with theory in order to get any results from it at all.

In conclusion I would like to say how interesting and valuable I found Dr. Snow's opening paper.

PROFESSOR J. H. JONES said that as he listened to Dr. Snow giving his address he was reminded of a story that used to be told by Mr. Hilaire Belloc. He had occasion to try to discover the site of a bridge that had been constructed by the Romans across the Seine. He consulted all the authorities: one authority said that the bridge was situated in a certain place, another said it was a mile up the river, another, two miles down the river, and so on. After consulting all the authorities he said that he came to one conclusion—there had been a bridge!

Dr. Snow, it would seem, denied that there even was a bridge: he objected to the word "trade," as though people engaged in professions were not working for their living; and he objected to the word "cycle." His objection to the word "cycle" appeared to be based upon a dictionary definition of the term, and what to him was essential in the definition was a regular time interval. That afternoon, having an idle moment, he (the speaker) had consulted the Oxford Dictionary, and found over a column devoted to the word "cycle," with only a few lines suggesting that it was essentially associated with a regular time interval. The word "cycle" was used in biology and other sciences to denote a sequence of events that was constantly repeated, but not necessarily repeated in the same time. There were definitions, even in that highly respectable volume, suggesting that regularity in the time interval was not an essential feature of a cycle.

Professor Jones knew there were others present who were extremely anxious to speak, and he therefore proposed to confine himself to a point upon which he was in full agreement with Dr. Snow. He agreed with Professor von Hayek and Mr. Hawtrey that there must be something more than a statistical statement of the phenomenon which was called a "trade cycle": there must be interpretation, and it was necessary to enter an entirely different field of thought and discussion in order to discover the various possible interpretations. But he would venture to submit, with Dr. Snow, that it was necessary that economists should know precisely the nature of the phenomenon which they were endeavouring to interpret, and that in economics they had been guilty in the past of assuming too much, and of avoiding what Dr. Snow had called the laborious investigation necessary to establish certain statistical truths constituting the phenomenon. He himself had been accused of doing that, and he might perhaps be allowed to plead innocent, because the statements to which Dr. Snow had referred were the result of such "laborious investigation." Along with two colleagues, both of whom were statisticians in the sense which Dr. Snow implied, he had examined a period of about seventy years and taken, as the item for investigation, the general level of prices. A line was drawn representing the long-term trend, and the centres of gravity of the areas above and below the straightened line of trend were marked. The distances of the centres of gravity from each other were then measured, both above and below the line. By this means they had avoided, they hoped, accidental variations in periods that were so likely to appear if they measured merely from peak to peak, producing cycles and time sequences that could be completely destroyed, as Dr. Snow had sought to destroy the sequence put forward by Professor Pigou. The method of measuring the trade cycle that they had employed was that of measuring the distances between these centres of gravity, which he ventured to submit was the best available method. They went a stage further, and over the same period, starting from the vertical line through the centre of gravity of each area above or below the trend, as the case might be, they examined the separate indices for various industries and various forms of economic activity, in order to see exactly where recovery began, or where the summit was crossed. This was done partly for the purpose of testing empirically the conflicting theories put forward by Mr. Hawtrey and Mr. Keynes. The results were negative as far as the controversy was concerned. But in the statement made—and made very cautiously with qualifications and covering statements—in the Bulletin to which Dr. Snow referred, they suggested that, even though they might have been unable to locate the bridge, there was a bridge!

Dr. M. S. Bartlett said that, as a mere novice in the economic world, he was not going to try to add anything very concrete to the mass of conflicting comments on the trade cycle. He would, however, like to be allowed to consider the trade cycle for a moment from the more abstract point of view, and proposed to start with the observation that to a mathematician the appearance of oscillations anywhere was not particularly surprising. Mr. Glenday referred, he thought, to that point in the last paper given to the Society, and remarked that the classical conception of equilibrium in a *laissez-faire* system might have little justification, not only in fact but also in theory. In the economic world it was not difficult to think of particular reasons for fluctuations, why fluctuations in the majority of industries would be linked and mutually interacting, or why the resultant oscillation would be large in amplitude—whether we tended to concentrate in our explanation, like Mr. Keynes, on the sensitive relations that existed between production and consumption, or sided with Mr. Hawtrey and stressed the destabilizing influence of credit expansion and retraction.

Dr. Snow would perhaps not feel satisfied with this somewhat vague argument, but it might perhaps suffice to justify the opinion, held also by former speakers, that while, without the need for any elaborate statistical analysis or very much practical experience, it seemed fairly clear that there was no trade cycle in any extremely narrow sense, the economists could legitimately extract out of the tendencies to which he had referred the conception of the trade cycle in the wider sense. He would not argue with Dr. Snow about what it should have been called, but he thought the term " trade cycle " had come to stay.

With regard to the problem of the *particular* causes of the trade cycle, he had mentioned two well-known schools of thought; but there was nothing necessarily inconsistent between all the reasons that had been advanced. The most satisfactory solution of the problem would seem to be one in which the relative importance of all those reasons had to be assessed, and that kind of solution was certainly difficult enough for all methods, statistical and theoretical, to find a place. He had gathered from Professor von Hayek's remarks that he would agree with that conclusion.

There had always been controversy in any science about the proper relations between facts and theories. In physics at the present moment there was acute controversy on that very point. The obvious answer was that they were not independent but complementary methods. Only in our more foolish moments did we make observations without rhyme or reason, or build theories without any reference to the facts. Dr. Snow and Mrs. Wootton, in her recent book, were to be congratulated on their criticisms of the modern tendency in economics for statistical fact and economic theory to be so carefully segregated. What he was thinking of, in connection with the trade cycle, was, for instance, that while theorists might mention that production in capital goods fluctuated more severely than in consumers' goods, or that real wages dropped in a boom—statements which he had no doubt were correct—it was quite common for references to any statistical evidence for such statements to be lacking, and certainly rare for the actual magnitude of those effects to be assessed.

Bearing in mind the views put forward that the trade cycle was a somewhat nebulous concept, he could not resist one last, perhaps not very original, comment on the ideal use, as he saw it, of a theory of the trade cycle, namely, not to confuse the man-in-the-street by dogmatic but often erroneous forecasts of the future state of his business, but to help us to find out whether the trade cycle was best left alone or whether some degree of planning, superimposed on our now somewhat decrepit *laissez-faire* system, could be expected to eliminate some of these oscillatory tendencies which did, admittedly, have far-reaching social effects.

MR. G. A. H. SAMUEL said Dr. Snow was to be complimented on the standpoint he took in preferring the solid basis of statistics to the methods of economists. He begged to be allowed to supply Dr. Snow with a basis on which he thought this problem might be attacked. It would be remembered that Lord Macaulay estimated that every pound taken forcibly out of trade by taxation inflicted in the long run a damage upon trade equal to ten pounds. Since Macaulay's time, he (Mr. Samuel) would reckon that the ratio of that damage had increased rather than decreased. The root of the idea was that money left in private hands circulated many times faster than money raised forcibly by taxation and subsequently expended. A flashlight upon that was obtained by what was going on in the United States, where they constantly endeavoured to infuse activity into trade by something like the method of the Irishman who cut a bit off the end of his blanket and sewed it on to the top, imagining that he had thereby lengthened the blanket.

This was a matter which Mr. Samuel believed would furnish a clue to the alleged mystery of the trade cycle.

MR. BALOGH was afraid that his contribution would not be as timely on Budget Day as that of the previous speaker. He would not attribute all our ills to taxation. There was a terminological part in the admirable paper delivered by Dr. Snow that had been dealt with by Professor von Hayek and Mr. Hawtrey. He would restrict himself to the last two sentences. There Dr. Snow explained, with truly statistical enthusiasm, that the future was with statistics. The material was getting so ample and lucid that they would form, in future, the basis of any valid explanation of economic phenomena. Economic theory, on the other hand, was of no use any longer. Circumstances changed with great rapidity, and these changes, in the view of Dr. Snow, necessitated a daily change of theory. It seemed to Mr. Balogh that the relation of statistics to economic theory was exactly the opposite of what Dr. Snow implied. If there were such continuous changes in basic circumstances, however great the volume of statistics pouring forth, their essential meaning was continuously altered, and by mere comparison we should get nowhere. At the same time, the very mass of statistics rendered analysis more difficult, if not impossible, and a very careful choice must be exercised if any light was to be thrown on the nature of the phenomena observed. This intelligent choice of data, however, pre-supposed a comprehensive knowledge of theory which enabled us to make a choice. To take an example. Unemployment data in Germany were much more comprehensive in Germany now than economic data in England before the War. They were uniform; they were unemployment figures; there was a uniform insurance scheme, and it would therefore be thought that the basis was the same; but one did not know how many men were in labour camps, how many were employed by the Army, how many were in prison, and how many were employed watching the prisons. In German unemployment figures the difference might go up to 30 or 40 per cent.

Dr. Snow did not make out his case that the change in the economic position necessitated a change of economic theory, which gives us the broad principles for the analysis of a particular position. It might well be that certain assumptions would have to be modified, but the more complicated the picture became the more important was the knowledge of the working of a simple theoretical model on the basis of which we could tackle more complicated issues.

MR. NORMAN CRUMP said he spoke partly as what Dr. Snow had described as the writer of the financial column, and was glad to have been given *carte blanche* to say exactly what he liked. In listening to the discussion his mind had been jerked back to an old jingle of his extreme youth which recounted the adventures of the three jovial huntsmen. He forgot the exact words, but it went something like this :—

One said it was a trade cycle,
The other he said, " Nay,
It's but a poor economist
That has gone and lost his way.
Look'ye there."

The first question that occurred to him was " What is a trade cycle ? " and this led him to the next question " What is good trade and what is bad trade ? " Primarily it was the statistician's job in one sense to measure the various phenomena which went to make up good or bad trade, and to say when they were good and when bad, how good, and how bad. But it was not the statistician's job only, because before he could do it he had to be told exactly what was to be measured.

Dr. Snow, in opening the discussion, laid some stress upon unemployment as a measure of good or bad trade, because he admitted that it afforded the only data obtainable in pre-war days. To-day there was a mass of data and it was necessary to pick and choose from that mass, form a picture, and make up their minds whether it was a good or bad picture. That was the practical note. Mr. Hawtrey approached it from the theoretical end, when he traced the whole thing back to the flow of money. Mr. Crump was not sure that the problem should not be approached from the point of view of the man in the street, who stood or fell by the results, and from that point of view employment went a long, if not the whole, way. There was practically full employment in Germany to-day. Here he might interpolate a comment upon a statement by Mr. Balogh. He, Mr. Crump, had been informed that the number of people in the armed forces, in the labour service, and in the party organization, was 1½ millions. But Germany also showed that employment was not the only test. It was not enough to be in work : it depended upon what was being received for the job of work, whether it was a good or bad wage, expressed in terms of what it could buy. As was the case in Germany, there might be full employment, but a low standard of living.

His next point was that it was rather tempting to argue that the real test was the volume of general consumption or the power of everyone to consume admirably: if it were possible to get a measurement of that, there would be some idea of whether trade were good or bad. Mr. Hawtrey had said that he was very doubtful if the present trade cycle had ended, and said he did not know when it was going to end. That raised the question, Was it going to end at all? As Dr. Snow had pointed out, there were new conditions to-day, and it might be that the whole of their previous experience counted for little at the present time. Three countries were now trying to get the trade cycle under control in three different ways. There was the cheap monetary regime in England, the "new deal" in the United States and, in Germany, the new conception that unemployment should be regarded not so much as an incurable failing but as a reserve labour force. Put crudely and shortly, before one could say that the trade cycle was a myth, two questions had to be answered, "What is meant by the trade cycle?" and "Is it not arguable that whether or no the trade cycle is a myth, it is to-day as dead as the dodo?"

The following contributions were received in writing, after the meeting.

MR. ROY GLENDAY: As I listened to Professor von Hayek and Mr. Hawtrey defending the economic method of attacking the problem of trade fluctuations, I was irresistibly reminded of an experience in my youth, when I was a member of an expedition prospecting chemical deposits in Central Africa. Our doctor, having in mind that it was intended to establish a factory to work the deposits, thought it might be useful even at that early stage to make contact with the medicine-men of the local tribe. He expected difficulty, being well aware of the extremely primitive condition of their culture, the low level of their intelligence and their very great attachment to the ancient fetishes of their tribe. Somewhat to his surprise, he met with a ready welcome. But not, it soon transpired, on account of any regard the natives might have for the superior intelligence and medical knowledge of the white man. On the contrary, his rôle was to be that of umpire in one of their own medical disputes. A severe quarrel, apparently, had broken out between the old and the younger medicine-men. Its origin was the proper method of treatment of certain highly contagious epidemic diseases—which for convenience I will call smallpox, measles and chicken pox—a characteristic symptom of which was the appearance of spots on various parts of the body. Being wholly ignorant of modern scientific method, the medicine-men followed the primitive custom of regarding every disease with similar symptoms—*e.g.* spots—as a manifestation of one and the same complaint. Some called it the "spots" disease, while others—ascribing its origin to planetary influences—referred to it as the "spots cycle." The cause of the quarrel was this: the younger medicine-men, having observed that an invariable symptom of an onset of a spot cycle was an increase in the temperature of the blood, maintained that spot cycles could be prevented entirely if only some method of "blood-letting" were employed at the appropriate time. Unfortunately the practice of "blood-letting" offended against one of the most ancient and established taboos of the tribe! Surely this is an almost exact analogy of the type of analysis used in most monetary explanations of the trade cycle?

May I incidentally remind Professor von Hayek that, while it may be correct to assert that analysis requires a combination of theory and fact, it is one thing to begin with an *a priori* theory and—as economists do—collect only the facts which seem likely to be able to be made to fit that theory, and quite another to start by investigating facts and allowing the explanatory theory to emerge, as it were, from the study of those facts. The former has been dubbed "a relic of mediæval barbarism"; the latter is the method of science.

With regard to the trade cycle itself, I would merely observe that in nature nothing endures and lives on for ever as it is. There is no such thing as uniform motion, but always acceleration and retardation, rise and fall—boom and slump.

MR. W. A. BASHAM: There was not time at the meeting to deal in detail with Dr. Snow's references, in his Appendix and elsewhere, to the Trade Union percentages of unemployment used in the Board of Trade Memorandum in the second Fiscal Blue Book, but as I was responsible for the figures contained therein and prepared the figures for the years to 1887, I should like to make a few remarks. Taking first Dr. Snow's Appendix (1), it hardly seems sound to calculate the percentage of the sample to the total occupied population of 1881 over 10 years of age when the members of Trade Unions were all, or practically all, adults and, I think, though I have not the material before me now, all males. The revised percentage would not perhaps appear much more impressive, but it would probably bear comparison with the percentages made use of in many of the "sample" statistical investigations now so frequently put forward with such confidence.

With regard to (2) I am in general agreement with Dr. Snow, but the Trade Union percentages never pretended to be from a random sample, whatever that may mean. They were calculated from the only material then available, namely, the monthly reports, etc., of Trade Unions which not only paid unemployment benefit but had also records of the members unemployed. (In one or two cases the Union records of unemployed members went back considerably beyond 1850). Paragraph (3) of the Appendix was written under some slight misapprehension, as the numbers unemployed were not calculated from the amounts paid out as benefit, except in a very few unimportant cases and for a short period, but from the numbers recorded as unemployed. Members on strike, lockout or "victimized" were separately recorded as being on strike, dispute or contingent benefit and it is very improbable that any members on strike can have got into the unemployment figures. As regards (4) I think Dr. Snow loses sight of the fact that in years of bad trade, when unemployment was severe, there was at the same time a great tendency on the part of employers to take advantage of the abundance of unemployed labour by pressing for reductions in wages, increases in hours of labour and more onerous conditions of work. If the high figure £150,000 of the Amalgamated Engineers for 1879 quoted by Dr. Snow includes strike pay (contingent it was called) it could easily be separated. Trade Unions over the period covered by the report did not mind disclosing the amounts disbursed for strikes. A good deal earlier in the century, it is true, much strike expenditure was concealed under other heads and I remember a union where in one year so much money was classed as funeral expenditure that, according to the scale of death benefit sanctioned by the rules, it was clear that all the members had died. But the high figures for 1879 were due to the great depression in that year. Trade was bad, agriculture was in great distress, the weather was bad and corn stood about in the fields until November. In addition, I believe, it was the worst year for fog in London. Luckily the depression was short lived.

(5) The low rate of employment in the building trades is principally due to the fact that the percentages are those of two unions (the Amalgamated Carpenters and the Operative Plumbers), representing occupations which even to-day have percentages of unemployment not more than half the percentage for the building trade as a whole. In the earlier part of the period covered by the Memorandum these two were craft unions composed of very skilled workpeople. With the last paragraph of section (6) I am in complete agreement, and I think it is quite unsound to claim, as many do, a greater intensity of unemployment for the recent depression on the ground that the percentages recorded by Ministry of Labour for the insured trades are in excess of the Trade Union percentages recorded for earlier depressions. I have never yet seen any statistical evidence that the depression of 1930–34 had, taking the country as a whole, a greater *proportion* of unemployed workpeople than, say, the depression of 1885–87.

DR. SNOW wrote in reply :—The discussion did not bring out so much opposition to the thesis developed in the opening statement as I had expected. Professor von Hayek thinks that I approved of the statement I quoted from the *Economic Bulletin* published by the Chartered Accountants under the ægis of Professor Jones. This may be due to the fact that I put in italics certain words which I wished to emphasize in the quotation, but I certainly do not agree with the view therein expressed. I do not think that the average length of trade fluctuations is the same in all industries. Industry is much too variable and complex for this to be true. Professor Jones, however, apparently has some unpublished analyses of statistical data bearing on this point, and it would be of great interest if this work could be published.

A curve representing the fluctuations of trade as a whole is a composite curve, based upon the experience of many separate industries. A curve for an individual industry is again a composite curve based upon the experience of many individual firms in the industry, and there is probably a good deal of variation in the experience of individual firms within an industry, just as there is variation among the different industries constituting the whole trade of the country. In the industry with which I am acquainted, it is almost true to say that the experience of no two firms is quite alike. Some make profits when others do not; some are in full employment when others have men on short time; some have considerable quantities of their products sold ahead when others find it difficult to get orders; and some carry substantial stocks when others have practically none. The industrial body seems to be as variable as the biological body. A relatively smooth curve can be produced representing the movements of an index for an industry as a whole, but it is an average for the firms composing the industry, and would differ appreciably from the corresponding curves for individual firms. The peak point of the curve representing the average might occur, say, in June, while the peaks for individual firms would spread over the whole of the year or might run into adjacent years, or might not even exist. I think that the existence of such variation within industry is not consistent with the conclusion that "there would come a time when the boom in some industries would occur during a period of general industrial depression."

Mr. Hawtrey considers that it is evidence of some degree of reliability in the Trade Union statistics of last century that in the period 1922–1926—when Trade Union statistics and Unemployment Insurance statistics were both available—they were in reasonable accord. I do not think this view is justified. In 1922 the Insurance Index averaged 6 per cent. over that of the Trade Union. In 1924 it was 33 per cent. higher, so that the concordance can hardly be considered good. But even if it were much better than in fact it was, the circumstances of 1922–1926 were so different from those of 1860–1914 that it would not be safe to place much weight on the concordance.

I was greatly pleased to read Mr. Basham's contribution to the discussion, as I had not hitherto been aware that anybody actively concerned with drawing up the admirable memorandum published by the Board of Trade as long ago as 1903 was still actively associated with the Society. I think the memorandum should be much better known that it is, as the paragraphs in the textbooks referring to it do it poor justice. It is one of those economic documents which the student should study in the original. The precautions necessary in interpreting the Trade Union data are clearly emphasised in the memorandum, and I think that economic students would have better knowledge on the subject of periodicity of employment fluctuations in this country if their knowledge were based upon this original research rather than on the accounts of it published in the textbooks.

As a result of the ballot taken during the meeting the candidates named below were elected Fellows of the Society:

Mary Posnett Newton.
David Dylan Pritchard, M.A.
Ernst Stern.
Harold Walker.

Corporate representatives.

Professor D. de Laky, *representing the* Statistical Seminar of the Jozsef Nador Mugeyetem, Budapest.

Edward Max Nicholson, *representing* Political and Economic Planning.

MISCELLANEA

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THE CONDITIONS UNDER WHICH SHEPPARD'S CORRECTIONS ARE VALID

By M. G. KENDALL

1. THE conditions under which corrections to the raw moments of a frequency-distribution are valid have been the subject of argument, and do not appear to have been formulated with any precision. In particular one meets with a certain amount of misapprehension about the necessity for high-order contact at the terminals of the distribution. The present note attempts to clear up the obscurity of the question and touches on a few points which have hitherto been given insufficient prominence.

2. Suppose there exists a frequency function $f(x)$ defined in the range $x = a$ to $x = b$, where one or both of a and b may be infinite. Without loss of generality we may consider $f(x)$ as equal to zero outside this range, and we may thus write:

$$\int_{-\infty}^{\infty} f(x)dx = 1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The frequency function so defined may be discontinuous at the points a and b even if it is continuous in that range. Outside the range $f(x)$ and all derivatives are identically equal to zero. I assume that $f(x)$ is in fact continuous in the range a to b and that if the range is infinite $f(x)$ converges uniformly to zero.

3. Suppose now that the range is divided into intervals of width h, and that, instead of the frequency function itself or its probability integral, we are given only the frequencies falling within those intervals. The frequency in the rth interval, centred at x_r, will then be given by:

$$f_r = \int_{\frac{h}{2}}^{\frac{h}{2}} f(x_r + \xi)d\xi \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

The raw moment of order s about the origin (an arbitrary fixed point) will be given by :

$$\begin{aligned}\overline{\mu}_s' &= \underset{r=-\infty}{\overset{\infty}{S}} (f_r x_r^s) \\ &= \underset{r=-\infty}{\overset{\infty}{S}} \left\{ x_r^s \int_{-\frac{h}{2}}^{\frac{h}{2}} f(x_r+\xi)d\xi \right\} \quad . \quad . \quad . \quad . \quad (3)\end{aligned}$$

Here the bar over the μ denotes that the moment is raw, and the dash that it is taken about a fixed point other than the mean.

The sth moment of the distribution, if it exists, is given by :

$$\mu_s' = \int^{\infty} x^s f(x)dx \quad . \quad . \quad . \quad . \quad . \quad (4)$$

The first question to be discussed is : what is the relationship between the $\overline{\mu}$'s and the μ's ?

4. The most direct way of solving the problem appears to be as follows :

We may put :

$$\frac{1}{h}\int_{-}^{\infty} F(x) = \underset{r=-\infty}{\overset{\infty}{S}} \{F(x_r)\} - R \quad . \quad . \quad . \quad . \quad (5)$$

where R is a remainder term regarded for the moment as defined by equation (5), which is thus true in general provided that the integral and the sum exist. At a later stage it will be necessary to consider R in detail, and certain conditions will have to be imposed in order that it may be neglected. Assuming for the present that these conditions are satisfied, we have, applying (5) when

$$F(x) = x^s \int_{-\frac{h}{2}}^{\frac{h}{2}} f(x_r+\xi)d\xi,$$

$$' = \frac{1}{h}\int_{-\infty}^{\infty} x^s dx \int_{-\frac{h}{2}}^{\frac{h}{2}} f(x+\xi)d\xi \quad . \quad . \quad . \quad (6)$$

$$= \frac{1}{h}\int_{-\infty}^{\infty}\int_{-\frac{h}{2}}^{\frac{h}{2}} x^s f(x+\xi)d\xi dx \quad . \quad . \quad . \quad (7)$$

provided that this multiple integral exists. If in addition it is absolutely convergent, we may substitute x for $x+\xi$ and integrate with respect to ξ. We shall then have :

$$\begin{aligned}\bar{\mu}_s' &= \frac{1}{h}\int_{-\infty}^{\infty}\int_{-\frac{h}{2}}^{\frac{h}{2}}(x-\xi)^s f(x)d\xi dx\\ &= \frac{1}{h}\int_{-\infty}^{\infty} f(x)dx\frac{\left(x+\frac{h}{2}\right)^{s+1}-\left(x-\frac{h}{2}\right)^{s+1}}{s+1}\\ &= \frac{1}{h}\int_{-\infty}^{\infty} f(x)dx\sum_{k=0}^{\left[\frac{s}{2}\right]} 2\,.\left(\frac{h}{2}\right)^{2k+1}\binom{s+1}{2k}x^{s-2k}\\ &= \sum_{k=0}^{\left[\frac{s}{2}\right]}\left(\frac{h}{2}\right)^{2k}\binom{s}{2k}\frac{1}{2k+1}\mu'_{s-2k} \quad . \quad . \quad . \quad . \quad . \quad (8)\end{aligned}$$

where $\left[\frac{s}{2}\right]$ is the integral part of $\frac{s}{2}$.

5. Equation (8) gives the raw moments in terms of the actual moments. In practice we usually require the latter in terms of the former, and from (8) we find the familiar expressions for Sheppard's corrections; *e.g.* up to the sixth moment:

$$\begin{aligned}\mu_1' &= \bar{\mu}_1'\\ \mu_2' &= \bar{\mu}_2' - \tfrac{1}{12}h^2\\ \mu_3' &= \bar{\mu}_3' - \tfrac{1}{4}\bar{\mu}_1'h^2\\ \mu_4' &= \bar{\mu}_4' - \tfrac{1}{2}\bar{\mu}_2'h^2 + \tfrac{7}{240}h^4\\ \mu_5' &= \bar{\mu}_5' - \tfrac{5}{6}\bar{\mu}_3'h^2 + \tfrac{7}{48}\mu_1'h^4\\ \mu_6' &= \bar{\mu}_6' - \tfrac{5}{4}\bar{\mu}_4'h^2 + \tfrac{7}{16}\bar{\mu}_2'h^4 - \tfrac{31}{1344}h^6 \quad . \quad . \quad . \quad (9)\end{aligned}$$

6. The assumptions made in reaching equation (8) are two: first that the integral of equation (7) is absolutely convergent, and second that R may be neglected.

The first condition is not in practice very restrictive, being equivalent to the requirement that the absolute moment of order s shall exist. If $f(x)$ is finite in range and bounded, the multiple integral is certainly convergent. In the contrary case, since $f(x)$ must tend uniformly to zero in the direction or directions in which the range is infinite,

$$\frac{1}{h}\int_{-\infty}^{\infty}\int_{\frac{h}{2}}^{\frac{h}{2}}|\,x^s f(x+\xi)\,|\,d\xi dx$$

will converge or diverge with

$$\frac{1}{h}\int_{-\infty}^{\infty}\int_{-\frac{h}{2}}^{\frac{h}{2}}|\,x^s\,|f(x)d\xi dx$$

i.e. with

$$\int_{-\infty}^{\infty}|\,x^s\,|f(x)dx$$

which is the absolute moment of order s.

7. The case stands very differently with the assumption that R may be neglected. In fact, unless further conditions are imposed on $f(x)$, R will generally contain terms comparable in magnitude with the corrective terms of equation (8), and consequently must be taken into account. If it is not, the "corrections" may be wildly wrong, and even "correct" in the wrong direction.

8. The conditions for the applicability of Sheppard's corrections to any given case are therefore in the main the conditions under which R may be neglected to a satisfactory degree of approximation. To take the matter further it is necessary to impose conditions on $f(x)$ so that use may be made of the Euler–Maclaurin formula :

$$\begin{aligned}\frac{1}{h}\int_a^{a+nh} F(x)dx = \{\tfrac{1}{2}F(a) + F(a+h) + F(a+2h) + \;.\;.\;.\\ + F(a+\overline{n-1}h) + \tfrac{1}{2}F(a+nh)\}\\ -\underset{r=2}{\overset{m-1}{S}}\frac{h^{r-1}}{r!}B_r\Big[F^{(r-1)}(x)\Big]_a^{a+nh} - S_m \quad . \quad (10)\end{aligned}$$

where $$S_m = (-1)^m\frac{h^m}{m!}\int_0^n (P_m(t) - B_m)F^{(m)}(a+ht)dt \quad . \quad (11)$$

In this form B_m stands for the Bernouilli polynomial of order m, *i.e.* the coefficient of $t^m/m!$ in the expansion of $t/e^t - 1$. Similarly $B_m(x)$ is the coefficient of $t^m/m!$ in $te^{xt}/e^t - 1$ and $P_m(x)$ is defined as the function of period 1 equal to $B_m(x)$ in the range $0 \leqslant x < 1$. We may recall that $B_{m+1} = 0$, $m > 0$ and $P_m(t) = (-1)^m P(1-t)$.

Now, suppose that if a, b are finite $f(x)$ and its first k derivatives vanish at the points a, b—*i.e.*, the distribution has terminal contact of order k. Then $f(x)$ and the first k derivatives are continuous through the range $-\infty$ to $+\infty$ and the function

$$F(x) = x^s\int_{\frac{h}{2}}^{\frac{h}{2}} f(x+\xi)d\xi \quad . \quad . \quad . \quad . \quad (12)$$

together with its first $k+1$ derivatives will also be continuous throughout that range. If, say, a is infinite (and similarly for b) we assume that

$$\lim_{x\to-\infty} x^s f^{(r)}(x) \longrightarrow 0$$

for all values of r up to and including k, in which case $F(x)$ and its first $k+1$ derivatives will also tend to zero. Thus in either case the Euler–Maclaurin expansion (10) is valid for $m = k+1$ and we may write :

$$[F^{(r)}(x)]_{-\infty}^{\infty} = 0$$
$$r \leqslant k+1$$

Substituting $F(x)$ as given by (12) in (10) we have, since $F(-\infty) = F(+\infty) = 0$:

$$\frac{1}{h}\int_{-\infty}^{\infty} x^s dx \int_{-\frac{h}{2}}^{\frac{h}{2}} f(x+\xi)d\xi = \underset{r=-\infty}{\overset{\infty}{S}} \left\{ x_r{}^s \int_{-\frac{h}{2}}^{\frac{h}{2}} f(x_r+\xi)d\xi \right\} + S_{k-1}$$

The first two terms in this equation lead us back to the Sheppard corrections of equation (8). There remains for consideration the remainder term S_{k+1}.

If a and b are finite and there are n intervals we have, for k odd

$$S_{k-1} = \frac{-nh^{k-1}}{(k+1)!} B_{k-1} F^{(k+1)}(a+\theta nh) \qquad 0 \leqslant \theta \leqslant 1$$

and for k even *

$$S_{k+1} = \frac{nh^{k+1}}{(k+2)!} B_{k+2}(\tfrac{1}{2}) \left\{ \begin{matrix} F^{(k+1)}(a+\theta_1 nh) \\ -F^{(k+1)}(b-\theta_2 nh) \end{matrix} \right\}$$
$$0 \leqslant \theta_1, \theta_2 \leqslant \tfrac{1}{2}$$

Now, $\dfrac{B_{2r}}{(2r)!}$ is less in absolute magnitude than $\dfrac{4}{36^r}$ † and so is $\dfrac{B_{2r}(\frac{1}{2})}{(2r)!}$

Hence S_{k-1} will be of order nh^{k+1} multiplied by some value of $F^{(k-1)}(x)$ in the range.

If the range is finite ($= nh$) S_{k-1} will thus be of order h^k times some value of $F^{(k+1)}(x)$.

Now, the greatest power of h in the corrections of equation (8) is $2\left[\frac{s}{2}\right]$. Hence, (1) if the order of terminal contact is k, (2) the range is finite, (3) $F^{(k-1)}(x)$ is not large in the range and

$$2\left[\frac{s}{2}\right] < k \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

---

* The first result is given by Milne-Thomson, "Calculus of Finite Differences," section 7.5. The second may be shown to be true by a similar treatment.

† In fact $B_{2r+1} = 0$ for $r > 0$ and

$$\frac{B_{2r}}{(2r)!} = \frac{2(-1)^{r-1}}{(2\pi)^{2r}} \underset{n=1}{\overset{\infty}{S}} \left(\frac{1}{n^{2r}}\right)$$

The sum on the right is less than 2 and hence:

$$\left|\frac{B_{2r}}{(2r)!}\right| < \frac{4}{(2\pi)^{2r}}$$

Further,

$$B_{2r}(\tfrac{1}{2}) = \left(1 - \frac{1}{2^{2r-1}}\right) B_{2r}$$

the corrected moment will be accurate to the order h^k—*i.e.*, to the order of the terms applied in making the corrections. This is the most general statement I have been able to deduce.

9. If the range is not finite the remainder term S_m of equation (11) may be written

$$S_m = \lim_{a,\, n \to \infty} \mathop{S}_{r=0}^{n-1} \frac{h^m}{m!} \int_0^1 (P_m(t) - B_m) F^{(m)}(a + ht + hr) dt \quad . \quad (14)$$

$$= \lim_{a,\, n \to \infty} \frac{h^m}{m!} \int_0^n (P_m(t) - B_m) F^{(m)}(a + ht) \quad . \quad . \quad . \quad (15)$$

I can see no general method of reducing this to such a form as equation (13); but in actual practice this case never arises, except accompanied by other approximations, because we never have the complete specification of the grouped frequencies of an infinite range. In cases where the range is infinite we are usually given the frequencies in the "material" part—*i.e.* frequencies outside a range determined by practical considerations are neglected. Provided that the contributions of the portions of the theoretical distribution outside the range are also negligible and (as almost inevitably follows) the terminal contact conditions are approximately satisfied at the practical terminals, the inequality (13) remains valid. It does not appear possible to be more precise on this point without imposing somewhat restrictive conditions on the nature of the tails of the frequency distribution.

10. I tested the inequality (13) on a number of Type II distributions with frequency functions given by:

$$f(x) = \frac{1}{B(p,q)} x^{p-1}(1-x)^{q-1} \qquad 0 \leqslant x \leqslant 1$$

with ten intervals of width 0·1 of the range. The results were at first sight rather surprising, and showed up Sheppard's corrections in a much more favourable light than the inequality might lead one to expect.

For example the distribution

$$f(x) = \frac{16}{\pi} x^{3/2}(1-x)^{1/2}$$

has zero contact at one end, and the first derivative at that end is infinite. It might have been expected from (13) that the group moments, even when corrected, would differ from the true moments quite materially. Actually I find, about the origin,

	Raw Moment	*Corrected Moment*	*True Moment*
μ_1'	0·624,713	0·624,713	0·625
μ_2'	0·437,752	0·436,918	0·437,5

The agreement for the first moment is quite good, all things considered. That for the second moment is not, for the raw moment is nearer to the true moment than is the corrected moment. In fact, the error of the corrected moment is of the same order as the correcting term 0·000,833.

11. The above is a very unfavourable case. For the distribution

$$f(x) = 6x(1 - x) \qquad 0 \leqslant x \leqslant 1$$

which is symmetrical and has zero contact at both ends (but finite derivatives) I find, about the mean $x = \frac{1}{2}$,

		Raw Moment	*Corrected Moment*	*True Moment*
μ_1	...	0	0	0
μ_2	...	0·050,82	0·049,987	0·05
μ_3	...	0	0	0
μ_4	...	0·055,918,5	0·055,667,317	0·053,571,428

The corrected second moment is accurate to order h^{-5}, much less than the correcting term. The corrected fourth moment is only accurate to order h^{-3} and the error is larger than one of the terms, $\frac{7}{240}h^4$, used in obtaining it. The corrections are an improvement, but they are not sufficiently precise to justify the use of this term, which would be better omitted altogether.

12. The distribution

$$f(x) = \frac{1}{B(12, 6)} x^{11}(1 - x)^5$$

is fairly skew, and has only fourth-order contact at one end. From (13) we should expect the corrected moments to be accurate to the order of the corrections for third and lower moments. Actually this is so; the fourth moment is accurate to order 10^{-5} but the correcting term $\frac{7}{240}h^4$ is smaller than the error. I find, about the origin

			Raw Moment	*Corrected Moment*	*True Moment*
μ_5'	...	...	0·168,512,9	0·165,847,9	0·165,869,2
μ_6'	...	...	0·125,433,2	0·122,574,0	0·122,599,0

The corrections are an improvement, but that to the fifth leaves an error of order 10^{-5}, of the same order as the correcting term $\frac{7}{48}\overline{\mu}_1'h^4$, and that to the sixth an error of order 10^{-5}, of the same order as two of the correcting terms $\frac{7}{16}\overline{\mu}_2'h^4$ and $\frac{-31}{1344}h^6$.

13. It is therefore quite possible that in a number of distributions occurring in practice quite good results will be obtained even when the condition of (13) is violated; but one cannot be sure, and there are two cases in particular wherein such an assumption would be dangerous :—

(*a*) if the distribution is markedly skew, for in such a case the discontinuity in $F^{(k+1)}(x)$ may be considerable;

(*b*) if the distribution is highly concentrated, *i.e.* the standard deviation is of the order of the group interval, for in such a case the moments will probably be of the same order as h^s and the " corrections " may outweigh the uncorrected terms. In fact the expression " accurate to a certain order in h " begins to lose any serviceable significance.

Nevertheless, the corrected moments may be an improvement in such instances. They will not, however, be sufficiently accurate to justify the use of the corrective terms of higher orders in h. For example, the distribution

$$f(x) = \frac{1}{B(11, 6)} x^{10}(1 - x)^5$$

has contact of the fourth order at one end. We should expect from (13) that the moment of the second and third order will be accurate to the order of h^2 and h^3, respectively, and thus that the full correction is justified. The fourth moment may not be accurate to the order $\frac{7}{240}h^4$, and it would probably be just as well to correct it and higher moments by omitting such terms—*e.g.* from (8) we should have :

$$\begin{aligned}
\mu_4' &= \bar{\mu}_4' - \tfrac{1}{2}h^2\bar{\mu}_2' \\
\mu_5' &= \bar{\mu}_5' - \tfrac{5}{6}\bar{\mu}_3'h^2 \\
\mu_6' &= \bar{\mu}_6' - \tfrac{5}{4}\bar{\mu}_4'h^2
\end{aligned}$$

Inasmuch as the first corrective term to all moments is of order h^2, we may expect that if the order of contact is 3 or higher $\left(> 2\left[\frac{2}{2}\right]\right)$, the corrections, even if applied in full, will result in an improvement.

14. The case when there is no terminal contact, as in J- and U-shaped distributions, has been considered by Pairman and Karl Pearson (1918), Pearse (1928), Elderton (1933) and Martin (1934). In such a case the ordinary Sheppard's corrections are no longer valid, and different corrections have to be employed. For the necessary formulæ, some of which require considerable arithmetical labour, reference should be made to the originals.

15. The corrections of equation (8) are obtained with reference to a fixed point. It is customary to apply them also to the moments about the mean *of the grouped distribution*—namely, by omitting the dashes in (8) and putting $\bar{\mu}_1' = \bar{\mu}_1 = 0$. Under the conditions already indicated this will be valid, for to the requisite degree of accuracy $\bar{\mu}_1' = \mu_1'$. (The group mean is, in fact, a fixed

point.) Further inquiry is necessary before it can be assumed that the same is true of the average corrections considered below.

16. One further remark is necessary to round off this treatment of the corrections. Equation (8) is fairly complicated, particularly when inverted so as to express the actual moments as linear functions of the grouped moments. When we deal with seminvariants the relations become beautifully simple. It will, in fact, be proved below—and it may be proved directly from equation (8)—that

$$\lambda_s = \bar{\lambda}_s - \frac{B_s h^s}{s} \quad . \quad s > 1 \qquad . \quad (16)$$

where B_s is the sth Bernoulli number as defined above (section 8). Odd values of B_s, except B_1, are zero.

This attractive result has been proved by Langdon and Ore (1930), Wold (1934), Kullback (1935), and C. C. Craig (1936). Wold also gives the corrections for factorial moments.

17. More recently Norton (1938) has made a novel approach to the problem by considering the limits, expressed in terms of raw grouped moments, between which the actual moments must lie whatever the form of the distribution. For example, taking an origin to the left of the start of the distribution, the actual moments cannot be smaller than those given by supposing that the frequency in the rth interval is concentrated at the extreme left-hand side of the interval—*i.e.* at the point $x_r - \frac{1}{2}h$. Similarly they cannot be greater than the values obtained by concentrating at the right-hand extreme of the interval—*i.e.* at the point $x_r + \frac{1}{2}h$. It is thus easy to see that:

$$\overset{s}{\underset{k=0}{S}} \binom{s}{k} (-\tfrac{1}{2}h)^k \bar{\mu}'_{s-k} \leqslant \mu_s' \leqslant \overset{s}{\underset{k=0}{S}} \binom{s}{k} (\tfrac{1}{2}h)^k \bar{\mu}'_{s-k}$$

and from these inequalities limits can be assigned to any moment about any point, provided that the range is not infinite.

18. There is a distinct type of problem which also leads to the equation (8). Given a distribution of unknown range and the frequencies falling into specified intervals, what corrections are to be applied to the raw moments so as to bring them *on the average* into closer relationship with the real moments? In other words, assuming that a large number of groupings are taken with the centres of the intervals falling with equal frequency anywhere in a range $\pm \frac{h}{2}$ about a set of fixed points distant h apart, what are the expected values of the raw moments in terms of those of the distribution?

19. Denoting by $E(\overline{\mu}_s')$ the average value of the sth grouped moment, we have :

$$E(\overline{\mu}_s') = \frac{1}{h}\int_{-\frac{h}{2}}^{\frac{h}{2}} \underset{r=-\infty}{\overset{\infty}{S}} (f_r x_r^s) dx_r$$

$$= \frac{1}{h}\int_{-\frac{h}{2}}^{\frac{h}{2}} \underset{r=-\infty}{\overset{\infty}{S}} x_r^s \int_{-\frac{h}{2}}^{\frac{h}{2}} f(x_r + \xi) d\xi dx_r$$

$$= \frac{1}{h}\int_{-\infty}^{\infty} x^s \int_{-\frac{h}{2}}^{\frac{h}{2}} f(x + \xi) d\xi dx$$

which is the same as equation (6), with the omission of R and the substitution of $E(\overline{\mu}_s')$ for $\overline{\mu}_s'$. Thus equations (8) and (9) are true of the expected grouped moments.

20. The same result may be obtained in a form which exhibits the corrections to the seminvariants more clearly. If two variables are independent, the characteristic function of their sum is the product of their characteristic functions, and the seminvariants of the sum are the sum of the corresponding semivariants of the constituents. Since the centres of the intervals are distributed with equal frequency over the range $-\frac{h}{2}$ to $\frac{h}{2}$, the variation due to grouping is independent of the variation due to the frequency distribution itself. Thus the characteristic function of the variation due to grouping, which is distributed in the form :

$$D(x) = \frac{1}{h} \qquad\qquad -\frac{h}{2} \leqslant x \leqslant \frac{h}{2}$$

is given by :

$$\phi(t) = \frac{1}{h}\int_{-\frac{h}{2}}^{\frac{h}{2}} e^{itx} dx$$

$$= \frac{\sin \frac{1}{2}ht}{\frac{1}{2}ht}$$

$$= \frac{\sinh \frac{iht}{2}}{\frac{iht}{2}}$$

The sth seminvariant of this distribution, κ_s, is given by :

$$\kappa_s = \left[\frac{d^s}{d(it)^s} \log \phi(t)\right]_{t=0}$$

and since

$$\log \frac{\sinh \frac{\theta}{2}}{\frac{\theta}{2}} = \overset{\infty}{\underset{s=2}{S}} \frac{B_s \theta^s}{(s!)s}$$

$$\kappa_s = \frac{B_s h^s}{s}$$

Thus, since

$$\bar{\lambda}_s = \lambda_s + \kappa_s$$

$$\lambda_s = \bar{\lambda}_s - \frac{B_s h^s}{s} \qquad s > 1$$

the result of equation (16).

Since this result is equivalent to equation (8) for moments, it remains true, under the conditions of section 8, for seminvariants in any particular case (not only on the average).

21. Sheppard's corrections regarded as average corrections do not require the conditions for terminal contact, and are thus legitimate for J- or U-shaped distributions. In fact, it is not even necessary that the distribution should be continuous—it may, for instance, consist of a number of arcs like a histogram.*

The average corrections do, however, require that the grouping shall be located at random on the range of the frequency distribution. This is a condition which is rather apt to be lost sight of, and it is more rarely fulfilled in practice than is sometimes supposed.

For instance, when we are grouping data of a distribution of known range, such as a correlation coefficient, it is almost inevitable to locate the outer edges of the terminal intervals at the extremities of the range. A similar situation arises for many J- or U-shaped distributions—income distributions naturally begin with an interval starting at zero, and deaths at given ages naturally begin with an interval starting at birth—*i.e.* zero age. In such cases the grouping is not located at random, and Sheppard's corrections are not legitimate even on the average.

22. It is also to be noted that for average corrections it is no longer legitimate to drop the dashes in order to obtain corrections for moments about the mean of the grouped distribution. This point has, I think, been neglected by all writers on the subject except H. C. Carver (1936).

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* For point distributions such as the binomial the appropriate corrections are different. If the frequencies are distributed at equal intervals $\frac{h}{m}$, m in each interval h, the average corrections are

$$\lambda_s = \bar{\lambda}_s - \frac{B_s h^s}{s}\left(1 - \frac{1}{m^s}\right)$$

cf. C. C. Craig (1936).

If the mean of the grouped distribution is $\bar{x}$, the average value of the sth moment about the mean is given by:

$$E(\bar{\mu}_s) = \frac{1}{h}\int_{-\frac{h}{2}}^{\frac{h}{2}} \mathop{S}_{r=-\infty}^{\infty} (x_r - \bar{x})^s \int_{-\frac{h}{2}}^{\frac{h}{2}} f(x_r + \xi)d\xi dx_r . \quad (17)$$

$\bar{x}$ is a function of x_r and in fact we have :—

$$\bar{x} = \mathop{S}_{r=-\infty}^{\infty} \left\{ x_r \int_{-\frac{h}{2}}^{\frac{h}{2}} f(x_r + \xi)d\xi \right\}$$

I can put forward no solution of (17) which is likely to be of any use in practice. A consideration of some particular distributions, however, supports the view that for all ordinary purposes it is sufficient to use equation (8) as if the mean of the grouped distribution were a fixed point.

For example, the mean of the grouped rectangular distribution is exactly the mean of the distribution, and hence equation (8) is exact for average corrections of mean-moments. Again, for the triangular universe

$$D(x) = \frac{2}{n^2h^2}x \qquad 0 \leqslant x \leqslant nh$$

it is possible to evaluate the average grouping corrections for mean-moments exactly. I find, for instance,

$$E(\bar{\mu}_2) = \bar{\mu}_2 - \frac{h^2}{12} + \frac{h^2}{180n^2}$$

i.e. a value in excess of the ordinary corrected term by $\frac{h^2}{180n^2}$. In practice n is hardly ever less than 10, so that this term will be less than $\frac{1}{1500}$th part of the usual correcting term $\frac{h^2}{12}$.

23. All the foregoing discussion has proceeded on the basis that the given grouped frequencies are actually those of the distribution whose moments are to be found. A further complication arises if the frequencies are merely samples from a parent whose moments are to be estimated. In such cases the procedure to be followed would depend to some extent on one's attitude towards the estimation of moments. Under the principle of moments (which lays down that the moments of the sample are to be identified with those of the parent) one would, I think, equate the parent moments to the corrected sample moments, provided that the sample was of such a nature as to support the belief that the parent had high-

order contact, or that the range of the parent and the nature of the sampling were such that the location of the grouping could reasonably be supposed to be random. (It makes no difference whether one identifies the parent moments with corrected sample moments or identifies grouped moments with grouped sample moments and then carries out the corrections.) The probable errors of moments so obtained are to be calculated from uncorrected moments.

If, however, one uses k-statistics or similar functions, there is a difference which may best be illustrated by an example. If m_2 is the uncorrected second moment about the sample mean, an estimate of the parent moment is :

$$\mu_2 = \frac{n}{n-1} m_2$$

If m_2 is calculated from grouped data one might apply the correction to it, obtaining :

$$\mu_2 = \frac{n}{n-1}\left(m_2 - \frac{h^2}{12}\right) \quad . \quad . \quad . \quad . \quad (18)$$

or, alternatively, one might correct the estimate, obtaining :

$$\mu_2 = \frac{n}{n-1} m_2 - \frac{h^2}{12} \quad . \quad . \quad . \quad . \quad . \quad (19)$$

(18) and (19) differ by the factor $h^2/12(n-1)$. This is in practice likely to be quite unimportant, but as a matter of theoretical interest it appears to me that (18) is the preferable formula, if, as usually happens, the sample is grouped *after* being drawn from the universe. If the sample is drawn from a grouped parent universe then (19) gives an estimate of the moment in the ungrouped parent.

24. The bibliography which follows is not, I expect, complete, but it contains all the work on the subject of Sheppard's corrections which I have encountered, and may be useful to others. The foregoing paper has dealt only with corrections in one variable, but Baten (1931), Wold (1934) and Craig (1936) have extended corrections to two variables, Wold also considering the general case of any number of variables.

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NOTES ON THE COUNT OF A PAGAN TRIBE IN WEST AFRICA

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General

THE following observations were made while supervising the annual re-count for 1937–38 made by the Native Administration in one of those Districts of Cameroons under British Mandate which is administered as part of the Adamawa Division of Northern Provinces, Nigeria. It is true the figures are on a very small scale, that the area in question is exceptionally remote and backward, and that the enumerators are both untrained and alien Moslems; consequently it is not to be supposed that the conclusions here indicated are typical for all the Northern Provinces. Nevertheless one can perhaps justly draw from this count the moral that, when a Decennial Census is taken for backward areas in African Colonies, more useful figures could be obtained, on the one hand by standardizing previous annual counts with specific view to Decennial Census requirements, and on the other by a reasoned " rectification," however unscientific, of the untrained counts on which nine-tenths of the Decennial Census figures are inevitably based.

Scope of Count

The area in question is that occupied by the so-called Mambila Tribe. This is one of the pagan, formerly cannibal, hill-tribes of the Western Sudan that were subjected during the latter years of the nineteenth century to slave-raids by the notorious Fulani of Northern Nigeria. It has practically speaking come under administration only since the Mandate. As usual, the immediate purpose of the annual count is to assess tax, which is here confined to adult males. The enumerators' efforts are therefore concentrated on entering adult males, and the figures are necessarily in some ways misleading—for instance, sick men are placed among the old, since both are non-taxpayers. At best, therefore, one cannot aspire to answer more than the most rudimentary statistical questions :—

(i) The adult male population.
(ii) The total population.
(iii) Is the population increasing or decreasing?

Previous Counts

Fortunately in this case there was an unusually good base on which to start comparisons; for the Mambila were carefully counted, as far as was then possible, by their District Officer, the late Captain T. A. Izard, when first brought under administration in 1926. To compare with his figures were various annual counts up to that of 1936, of which I quote that of 1930 (which was used for the Decennial Census of 1931) and one other :—

Year	Adults		Infirm		Children		Total
	Male	Female	Male	Female	Male	Female	
1926 ...	**3,746**	3,717	150	370	2,743	2,339	13,065
1930 ...	**5,040**	4,005	101	202	3,622	3,231	16,201
1934 ...	**5,619**	3,779	79	168	1,747	1,978	13,370
1936 ...	**6,116**	4,577	82	151	1,599	2,222	14,747

Note.—Officially "children" are "under 16."

These figures give, what is always gratifying to the Administration, a regular and considerable increase in taxpayers. But a glance at the subsidiary figures indicated that there must be something wrong in the enormous preponderance of adult males over females and in the recent shortage of children. It did not take long to discover where at least part of the lopsidedness arose. At the very first check in a hamlet of 45 adult males, two boys scarcely more than ten years old were brought up as being taxpayers, and at the next, a hamlet of 90, there were seven more. That put an end to hopes of any close scrutiny of the population: obviously all attention must be directed to correcting the tax-lists.

Result of Count

Counting 250 scattered and mountainous hamlets is arduous work, and it took three scribes three weeks to cover the tribe. Eventually the following figures were obtained :—

Year	Adult		Infirm		Children		Total
	Male	Female	Male	Female	Male	Female	
1937 ...	5,728	4,534	150	227	2,413	3,045	15,897

As a check every Hamlet Chief is called up after his count, and brings a bundle of straws representing his idea of the number of his taxpayers, which is compared with the official list. This check is by no means infallible, partly because of the Chiefs' nebulous ideas of the age of sixteen, and partly because of the presence of more or less permanent visitors; nevertheless the figure 5,728 seemed to be fairly accurate, erring if anything on the high side. The same could not be said, however, of the subordinate figures, which show the same preponderance of males and shortage of children as the previous year's figures. The question was how to "rectify" things.

Special Test Counts

During the work special house-to-house counts were made in two villages, Bamga and San, in order to provide examples of (*a*) the relative figures of male and female, and (*b*) the proportion of non-adults to adults. The figures obtained were as follows ("A"):—

Village	Adults		Infirm		Children		Total
	Male	Female	Male	Female	Male	Female	
Bamga ...	659	440	19	69	264	431	1,882
San ...	176	140	8	12	94	109	539
Total ...	835	580	27	81	358	540	2,421

(*a*) Applying these as test-figures for the incidence of the sexes one gets:—

Village	Males	Females	Females per 100 Males
Bamga	942	940	99·8
San	278	261	93·9
Total	1,220	1,201	98·5

Now, in most of the Northern Provinces of Nigeria, so far as the figures can be trusted, females outnumber males, the average figure (1931) being 111·4 to 100. In India, on the other hand, males are in the majority by 100 to 95·2 (1921). Mambila figures have always provided an exception to this preponderance of females in the Northern Provinces, and there is no reason to deny their correctness merely because they differ from those of neighbouring tribes in this respect. Nevertheless it is significant that in the two villages carefully counted the proportion of females is so much higher than in the remainder; indeed, one hamlet of Bamga gave a preponderance of females of as much as 119 to 100. Compare with these new "special" figures the totals for the whole Mambila :—

Year	Males	Females	Females per 100 Males
1926	6,639	6,426	96·8
1930	8,763	7,438	84·8
1934	7,445	5,925	79·6
1936	7,797	6,950	89·1
1937	8,291	7,606	91·7

The proportion of females in the General count (91·7) thus fell short of that in the Special count (98·5) by nearly 7 per cent. To rectify the former, therefore, one might be justified in merely adding 7 per cent. all round to the female columns. Such an alteration is not so arbitrary as it seems, since there is a further reason to think that females are under-counted. The census forms are arranged to include by name only the householders; dependants are shown merely by numbers. Consequently, although every compound is supposed to be entered, it is not difficult for the enumerator to overlook one in which there is no adult male, and similarly, although a man is expected to declare all his dependants, he tends to leave out those other than his wife and children. But merely to increase the numbers of females would not give balanced figures, since it would leave the misproportion of children to adults.

(*b*) Turn now to the incidence of ages :—

Village	Males			Females			Total, %
	Non-adult	Adult	%	Non-adult	Adult	%	
Bamga ...	264	678	38·9	431	509	84·5	58·4
San ...	94	184	51·1	109	152	72·6	60·6

With which one may compare the following figures for India and for the Northern Provinces as a whole :—

Particulars	India (1921)	N P (1931)
Children per 100 adults (male)	64·8	58·1
,, ,, ,, (female)	63·7	51·2
,, ,, ,, (total)	64·2	54·5

On the face, the *total* percentages of the two Mambila villages are reasonable, but those for each sex separately are practically impossible. One's first assumption is that the sexes have been wrongly declared, and that a number of female children need to be transferred to the "male non-adult" column, leaving the total unchanged. But here local knowledge comes in. There is no known reason why children should have been uniformly declared of the wrong sex, and nothing outside the figures to suggest that they have been so misdeclared. Furthermore, a transfer to males from females would alter the balance of the sexes and increase the preponderance of males. This explanation must therefore be rejected.

The alternative is that girls over 16 have been entered as non-adult. This, as was mentioned above, is probable; for, while the enumerator would be liable to enter unmarried lads even before 16 as adults, he would not as a rule enter unmarried girls in the adult column, which consists chiefly of wives. If women were taxpayers, the list might be very different. The tendency to decrease "women" and increase "girls" comes, in fact, from the Mambila marriage-custom, which is that a youth and his bride cohabit for some years in her father's house before she is taken to the bridegroom, and they are consequently not classed as "married" until comparatively late in life. This fact probably accounts for the unlikely preponderance of males in lists of this tribe which was discussed above, while conversely early marriage accounts for some of the preponderance of females in the lists of Moslem tribes over the rest of Nigeria. Now, it can be shown * that girls of the four ages 16–19 inclusive constitute about 10 per cent. of the female total in a community

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* The "Intensive Census" totals of the Northern Provinces 1931 Census give figures indicating the population in five-year age-groups, which work out (to the nearest half per cent.) as follows :—

Ages	0–4	5–9	10–14	15–19	20–24	25–29	30–34
Males ...	17·5	13·0	10·0	9·5	8·5	8·0	7·0
Females ...	17·0	13·5	8·5	9·5	9·5	9·0	7·5

(The female figures 10–24 are clearly erroneous.)

Ages	35–39	40–44	45–49	50–54	55–59	Over 60	Total
Males ...	5·5	5·0	4·5	3·5	2·5	5·5	100·0
Females ...	6·5	5·0	3·5	2·5	2·0	6·0	100·0

Group 0–1 is given as rather under 6 per cent., leaving group 1–4 as 11½ per cent., and the approximate figure for ages 1, 2, 3 and 4 as around 3 per cent. each. With a tolerably constant birth-rate there must be slightly less people of any given age than of the next year below it, but one may say roughly from the above figures that each of ages 1 to 9 constitute 2½ to 3½ per cent. of the total, while each of the years 10–19 constitute 2½ to 3½ per cent.

In the Mambila Tribe, with shorter lives, the percentage of young persons is evidently rather higher; hence the allowance of 2½ per cent. for girls of 16 to 19 and that of 2½ per cent. for boys of 15.

with the short expectation of life of the Mambila; probably, therefore, it is safe to take as much as 9 per cent. away from the figure of girls and add it to "adult females"—*i.e.* in Bamga 85, in San 23. The change would give the following figures :—

Village	Males			Females			Total, %
	Non-adult	Adult	%	Non-adult	Adult	%	
Bamga ...	264	678	38·9	346	594	58·0	48·0
San ...	94	184	51·1	86	175	49·1	50·1

In some parts of Nigeria such figures would appear very probable, but to anyone who has seen the very large number of children in these Mambila villages, so low a percentage of non-adults can scarcely be accepted. Children away on the farm scaring birds or visiting relatives were found to have been overlooked. It is, therefore, pretty certain that yet one more adjustment must be made to obtain something like the true figure—a straightforward addition to the number of non-adults of, say, 20 per cent. This change, which is admittedly just guesswork, gives :—

Village	Males			Females			Total, %
	Non-adult	Adult	%	Non-adult	Adult	%	
Bamga ...	317	678	46·4	415	594	69·9	57·6
San ...	113	184	61·4	103	175	58·8	60·0
Total ...	430	862	49·9	518	769	67·3	58·1

A final test figure has thus been evolved ("B") :—

Village	Adults		Infirm		Children		Total		Total
	M.	F.	M.	F.	M.	F.	M.	F.	
Bamga ...	659	525	19	69	317	415	995	1,009	2,004
San ...	176	163	8	12	113	103	297	278	575
Total ...	835	688	27	81	430	518	1,292	1,287	2,579

which gives an increase of 6·5 per cent. over the actual count (2,421). Except that the Bamga have fairly evidently been more ready than the San to declare the border-line boys of 15 to 16½, these figures are probably tolerably correct, and would bear using as a base for statistics of a very rough kind.

At the same time it would be wrong not to consider the alternative possibility that the actual count, with its total of 2,421, was approximately correct, and that the mistake lies in the "adult male" column, which on this assumption still includes boys under 16 in large numbers. Since, however, a fair portion of the newly-entered boys were brought for inspection, and they seemed all to be well on towards 16 at the least, this alternative is not the more likely.

Factor of Adult Males to Total Population

Whichever is right—*i.e.* whether the "adult male" figure has to be decreased or the "total" figure increased—in either case the proportion of total population to adult males (including infirm) is almost exactly 3 to 1; this proportion gives a valuable formula by which to check the count both in individual villages and in the tribe as a whole, or rather in the Southern section of the tribe, in which the two villages are situated. In the Northern section, which has come in some degree under the influence of Moslem culture, the birth-rate is lower, and similar calculations indicate the factor of total population to adult males to be about 2·8 to 1. Both these factors are noticeably smaller than those obtainable from the 1926 figures, and may be on the low side.

Application to General Count

Revised in the light of these factors, the 1937–38 population of the whole tribe would be estimated as follows :—

	Adult Males	Factor	Total
Northern Section	2,485	2·8	6,958
Southern Section	3,393	3·0	10,179
Total (rectified)	5,878	2·9	17,127

It must be observed that these figures are obtained by second-line rectification—*i.e.* they are rectified from once-rectified test-figures. As a rule, one might hope to obtain test-figures which could be used without requiring "rectification" themselves.

It had been hoped by calculating the percentage of "over sixty" to obtain a rough idea of the expectation of life (and thus of taxpaying life) in the tribe, but the figures are too dubious and too much subject to qualification to be of much value. For "infirm" includes blind persons and other invalids, as well as the old, and excludes a number of healthy "over-sixties." The approximate figures, for what they are worth, are as follows :—

Year	Over Sixty		Total Population		Number of Old per 1,000		Total
	Male	Female	Male	Female	Male	Female	
1926 ...	82	321(?)	6,639	6,426	12·4	42(?)	30·7
1937 ...	95	187	8,291	7,606	11·5	24·6	17·7

These proportions can be contrasted on the one hand with European figures (*e.g.* France, 1930, with 135 per thousand over 60), and on the other with the figures obtained in the units covered by " Intensive Census " in the Northern Provinces Census of 1931 :—

Year	Over Sixty		Total Population		Number of Old per 1,000		Total
	Male	Female	Male	Female	Male	Female	
1931 ..	11,412	12,788	214,452	224,337	53·2	57·0	55·6

Even allowing a wide margin for error in the Mambila figures, one is safe in saying they are distinctly shorter-lived than the average of the Northern Provinces, and as a corollary can be expected to show a higher proportion than the average at the younger ages.

Trend of Population

The second of the questions put at the start has now been dealt with. There remains the third, " Is the population increasing or decreasing ? " On the face there has been an increase since 1926 :—

Year	Adult Males (including Infirm)	Factor	Total Population
1937–38 (rectified) ...	5,878	2·9	17,127
1926 (unrectified) ...	3,896	3·3	13,065
Increase in 11 years ...	1,982 = 50·1%	—	4,062 = 31·1%

Before discussing these increases, however, one must test the 1926 figures. These were given earlier, and show the following proportions :—

(*a*)	Females per 100 males	96·8
(*b*)	1. Children per 100 adults male	70·0
	2. " " " " female	57·2
	3. " " " " total	63·7

Of these all except the "children per 100 adults male" compare reasonably with the final figures reached for the two special villages in 1937–38 ("B"). The exception indicates that youths were not entered into the taxpayers' list in 1926 until older than those entered in 1937–38—hence the high proportion of 70 children to 100 adults, as compared with 49·9. The disparity can be corrected by transferring to "adults" about 10 per cent. of the "boys"—that is 274—on the assumption they were over 16 at the time. This makes the adult male figure 4,170 instead of 3,896. Such an alteration may seem to be exceeding the bounds of arbitrariness, but really nothing is more probable than that a District Officer on a practically pioneer visit should have been especially careful to omit from the taxpayers' roll anyone about whose age there was the least doubt. The figure 274, which is just over 4 per cent. of the male population, would represent rather less than the years 16 and 17. Judging by the "factor" thus obtained (3·1), the number of boys transferred to "adults" is on the low rather than the high side :—

Year	Adult Males (including Infirm)	Factor	Total Population
1937–38 (rectified) ...	5,878	2·9	17,127
1926 (rectified)	4,170	3·1	13,065
Increase in 11 years ...	1,708 = 40·9%	—	4,062 = 31·1%

which gives an annual increase, at compound rates, of just over 3 per cent. per annum for adult males and somewhat under 3 per cent. for total population. Between 1926 and 1930 the Northern Provinces as a whole showed annual increases varying from 2·2 per cent. to 3·2 per cent. per annum, but previous and subsequent figures indicate that little confidence can be placed in such regular increases.

In the instance of the Mambila, proof whether there is or is not a natural annual increase ought to be fairly clearly obtainable from the figures of adult male deaths and of males reaching adult status, which form part of the routine tax statistics in this division, though not throughout the Northern Provinces. Unfortunately these figures are obtainable for only one year so far, and are not yet reliable; but roughly speaking, the adult death-rate seems to be around 20 per thousand, and the puberty-rate nearly 40. In any case the natural increase seems hardly to be higher than 2 per cent.

If this were all, it would be easy to explain the difference of 1 per cent. between the actual calculated increase (3 per cent.)

and the estimated natural increase (2 per cent.) as being due to immigration and the return of ex-slaves. Unfortunately, though the tribe in total gives, as was shown at the start, fairly even increases through the eleven years, the individual villages give exceedingly uneven figures. While some of the backward Southern villages show increases in adult males of nearly 100 per cent., the Northern ones actually show decreases—*e.g.* (unrectified figures) :—

Section	Village	Particulars	1926	1934	1937
Northern.	Titon.	Adult Males.	142	132	145
		Total Population.	456	310	384
		Factor.	3 2	2·4	2·7
,,	Yirum.	Adult Males.	54	58	55
		Total Population.	183	134	126
		Factor	3·4	2·3	2·3
,,	Gubin.	Adult Males.	127	178	139
		Total Population.	497	374	375
		Factor.	3·9	2·1	2·7
Southern.	Tamnya.	Adult Males.	68	91	119
		Total Population.	219	216	288
		Factor.	3·2	2·4	2·4
,,	Vokude.	Adult Males.	192	279	295
		Total Population.	618	586	704
		Factor.	3·2	2·1	2·4

"Rectified" on the lines taken earlier, these figures would read :—

Section	Village	Particulars	1926	1934	1937
Northern.	Titon.	Adult Males.	151	132	145
		Total Population.	456	369	406
		Factor.	3·0	2·8	2·8
,,	Yirum.	Adult Males.	57	58	55
		Total Population.	183	162	154
		Factor.	3·2	2·8	2·8
,,	Gubin.	Adult Males.	139	178	139
		Total Population.	497	498	390
		Factor.	3·6	2·8	2·8
Southern.	Tamnya.	Adult Males.	72	91	119
		Total Population.	219	273	357
		Factor	3·0	3·0	3·0
,,	Vokude.	Adult Males.	205	279	295
		Total Population.	618	837	885
		Factor.	3·0	3·0	3·0

It is thus difficult to resist the double conclusion :

(1) that the more primitive Southern villages were under-counted in 1926, and consequently that the total increase in the tribe since then is even less than the "rectified" figures show.

(2) that in the more advanced Northern villages the natural increase must be very small, if indeed the population is not in fact decreasing

The latter conclusion, even if not proved, is staggeringly different from the increase of 63 per cent. in ten years, which a casual glance at tax-figures suggested, and an administration which based future estimates on those figures might find itself badly shocked. The satisfactory yearly increase of taxpayers turns out to be only the efforts of native staff to keep up the revenue. It must again be emphasized that the tribe in question, owing to its short period of administration, is exceptional; yet the figures point a moral of wide application.

It remains only to revert to the point first suggested—namely, how much improvement is needed if plausibility is to be obtained in decennial censuses in 1941. Our figures :—

Count	Year	Adult Males (including Infirm)	Total Population
Original	1936	6,198	14,747
Rectified	1937	5,878	17,127
Difference	—	−5·1%	+16·1%

indicate the shifting sand on which calculations made direct from untrained enumerators' figures may be founded.

NOTE

The Nigerian Government accept no responsibility for the accuracy of the information contained in the notes.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

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1.—*Manuale di statistica. Introduzione allo studio quantitativo dei fatti sociali.* By Felice Vinci. Bologna: Zanichelli, Vol. I, 1936, viii + 300 pp., *L.* 32; Vol. II, 1937, 353 pp., *L.* 40. 10″ × 7″.

Many a British reader of Professor Vinci's book will probably be shocked by the inadequacy of presentation of certain chapters of the theory of statistics which are familiar to him. These are what are usually covered by a somewhat vague term of "statistical inference," really the theories of testing statistical hypotheses and of estimation. Far from discussing methods, or even the necessity of choosing the criteria or the estimates, the book does not even contain the description of "Student's" test, without which a textbook of statistics would surely seem unthinkable. The estimates suggested are those which, probably, seemed "natural," and the only tests described are: χ^2 in its "pre-war" form, the Lexis' coefficient of dispersion, and the use of approximate formulæ for standard errors, in which one is advised to substitute for the values of various parameters their estimates calculated from the sample. Seeing all this, one is a little amused by the remark at the bottom of p. 286, Vol. II, to the effect that "one must lament the tendency to sacrifice to practical considerations that accuracy of method which is characteristic of the Russian and the Italian schools." It is true that the theory of testing hypotheses and its necessary complement, the theory of small samples, are chiefly applied in biology, etc., while the book under review is concerned with social problems. However, even in this respect we find unexpected deficiencies. It is known that hardly any of the more delicate statistical enquiries into social problems can be based on the data of general censuses, since these cannot include too many questions and cannot be frequently taken. The enquiry by sample becomes more and more popular and important, and one would expect to find its theory described in detail in a book like the one under review. Yet the method of sampling is dealt with in a paragraph of about two pages only (Vol. II, pp. 120–22) and most inadequately.

The above remarks may suggest that the reviewer is inclined to condemn Vinci's work entirely. This, however, is not so. On the contrary, readers of this *Journal* will probably find the book both interesting and useful. The scope of mathematical statistics is exceedingly broad, and it is difficult to produce a book covering all the ground. While omitting certain of the chapters of statistical theory, Professor Vinci emphasizes others of perhaps equal importance. The first volume contains an interesting Introduction and a "Parte Prima" on methods of representing and of grouping the observations. It deals with various methods of tabulation—a very instructive chapter—with graphical methods, with averages, and with problems of smoothing and interpolation. This last chapter contains about 100 pages, and is particularly well written. The second volume is divided into two parts. The first deals with stochastic schemes leading to various distributions of one variable. Here, for the first time, we find the classical definition of probability, fundamental theorems of addition and multiplication of probabilities, the deductions of the binomial and the Poisson distribution, etc. The author discusses the mathematical law of large numbers and, using the inequality of Bienaymé–Tchebycheff, proved previously in Vol. I, proves the theorem of Bernoulli. Next comes the deduction of the normal law as a limit of the standardized binomial. But the author does not stop there, and proceeds to explain the particular steps, without going into the details, of the proof of the theorem of Liapounoff. In this way the statistical reader, even if he is not too familiar with all the intricacies of mathematics, is introduced to the modern theory of probability.

We do not often find in text-books an adequate description of the link between the abstract theory of probability and the facts of the external world. This is very well described by the author in his formulation of the empirical law of large numbers (*la legge statistica del caso*). Also many readers will be interested in the discussion of various cases of dispersion, of Pearson curves, etc.

The last part of the book is concerned with problems of more than one variable. The first chapter gives a comprehensive theory of indices. Next come various problems of demography, methods of constructing such tables as those of mortality, their analytical representation, the conception of a stationary population and of the machinery of its changes. This brings the reader to the next chapter, not a long one, on time series. Next comes the chapter on correlation, with a symptomatic paragraph on abuses in interpretations of the coefficient of correlation. The last chapter is given to modern economic and social theories as developed by the Econometric School. The reader is introduced to Irving Fisher's equation of exchange, to the "hereditary" theories of oscillation of prices, their connection with the mathematical theories of Volterra, and to the latest developments by Amoroso, Evans, Frisch, Kalecki and Tinbergen.

Both volumes end with appendices giving some incidental information. In the first volume we find a chronological list of outstanding events in the history of statistics in modern times. It starts with the first weekly return of deaths in London, 1532, and ends with the publication of G. H. Knibbs's *The Mathematical Theory of Populations* in 1917. Besides the latter, only three main events of the twentieth century are mentioned: the publication of the first volume of *Biometrika* (1901), the publication of Mr. Yule's *Introduction* (1910) and that of A. J. Lotka's *A Problem in Age-Distribution* (1911).

A corresponding Appendix in Vol. II gives some information of various national and international statistical societies and research institutions. There are a few tables.

As I have mentioned before, in spite of certain questionable points, the book is well worth reading and possessing. J. N.

2.—*Wie statistische Zahlen entstehen. Die entscheidenden methodischen Vorgänge.* Von Franz Žižek. Leipzig: Buske, 1937. 9″ × 4″. 151 pp. *Rm.* 4.50.

As is stated in the introductory chapter, the object of the book is to bridge a gap between the "producer" and the "consumer" of statistics. Everybody nowadays has opportunities of both discussing statistics (*e.g.* fluctuations in road accidents or of the number unemployed) and contributing to their formation (*e.g.* by filling up a questionnaire or merely by going to a cinema). The professional statisticians know of the processes which lead from single records to the statistical series as they appear in official publications. Professor Žižek gives an outline of simple conceptions and methods involved, and considers his book as a contribution to the general statistical methodology. It is perhaps surprising that the book does not contain any single formula or any numerical example.

The subject of "general statistical methodology" is subdivided under three headings: (1) The object to which statistical methods are applied = populations of individuals with varying individual characters; (2) the aim of the enquiry considered in any particular case and (3) the methods to be applied, which must be in conformity with (2).

The questions which are discussed—in a very systematic way—may be exemplified by the distinction between a single person and the unit of the populations studied. The unit of the population may consist of just one person (*e.g.* in statistics of unemployment), of many persons (*e.g.* in statistics of households) and again a single person may form part of a number of units of the population (*e.g.* in criminal statistics). The statistics of estates are not identical with those of landlords, etc. J. N.

3.—*Mathematical Analysis for Economists.* By R. G. D. Allen. London: Macmillan. 1938. 6″ × 8¾″. xvi + 548 pp. 31*s.* 6*d.*

Mr. Allen has written this book, one of the London School of Economics Studies in Statistics and Scientific Method, for economic students who need mathematical equipment to follow modern developments. The mathematician at first sight is highly suspicious of any such attempt. For his calculus ranges over such a wide field that the professional mathematician himself never knows when he may not have to master some out-of-the-way work of some of his fellow-students, as in recent years he has had to do in the matter of tensors, matrices, hypergeometry, theory of numbers, and what not, to develop his own investigations. There is nothing, apparently, in economics as such that may not lead it to require similar unsuspected help in its explorations by mathematical methods. But as he reads Mr. Allen's book he attains more confidence. Mr. Allen has given an outline of mathematics that will help the non-mathematician to understand much of the more mathematical side of economics. Mathematically it is reliable, and pedagogically it shows the hand of the practised teacher who is master of his subject. Mr. Allen indicates some of the recent work that has been done by himself and by some of his colleagues of the School of Economics, and other modern developments of his science. His illustrations are carried out in some detail into economic theory: it would, however, have been a help if the writer could have indicated a little more definitely to what extent the formal formulæ that he uses are accurate representations actually realized in practice of the measures of the variables (demand, etc.) concerned. He does not, in fact, deal anywhere with the compilation of statistics and their representation by any empirical formula save for a fleeting reference to average and standard deviation of a frequency distribution, to Pareto's Law, and to the logistic curve. The same remoteness from the practical issues seems to lead to a certain vagueness at times in reference to rate of interest (as a rate of so much per cent. per annum) and to the dimensions of price (as a price rate, *i.e.* pence per lb., etc.) as distinct from revenue. We have detected only one slight misprint (p. 216, where 32 is written for 3 . 2 or 3 × 2). The publishers are to be congratulated on the whole get-up of the book, though here also we may perhaps make a suggestion: a reference to para. 17, 3, Ex. 1 (as on p. 163), where there are no headings to the pages to give the section numbers, means some little search before finally it is located on p. 454, whilst the order of reading the four diagrams of p. 192 is not clear: which are the "first two cases"? But these are minor points. The book is original, sound alike in its matter and in the manner of presentation, and should be highly useful to students of the kind for whom it is intended. F. S.

4.—*Some Theoretical Problems suggested by the Movements of Interest Rates, Bond Yields and Stock Prices in the United States since 1856.* By Frederick R. Macaulay. National Bureau of Economic Research. New York. 1938. $9\frac{1}{4}'' \times 6\frac{1}{2}''$. 500 pp. $5.

This immense volume is number 33 of the publications of the National Bureau, and unmistakably lives up to the high reputation of that series for research into facts. Its size is largely accounted for by the wealth of statistical data which Dr. Macaulay has accumulated. The text, which is liberally illustrated by excellent charts, only covers some 235 pages, though to this may be added another 45 pages of appendices not devoted to figures.

After an interesting introduction largely dealing with the scientific method in economics, the author plunges into a detailed discussion of the concept of long-term interest rates. This is useful because it is a subject that tends to be neglected by economists, who, in the nature of things, do not come very closely into touch with the problems of bond valuation. In this chapter Dr. Macaulay makes clear what he means by the yield of a bond, and develops the concepts of the "duration" of a bond and the "implicit" rates of interest related to the issue price of a new bond of a given nominal rate.

In Chapter III the author has little difficulty in convincing the reader that there are considerable practical and theoretical difficulties in comparing long-term interest rates over an extended period of time. At the end of the chapter the idea of "economic drift" in bond yields is introduced. By this is meant the change in the spread between the yield of high- and low-grade bonds of a particular industry as, decade after decade, that industry passes through a period of health and growth or decadence and decay. The importance of this gradual movement, if we are interested in comparing the changes in yield of a given grade of bond, cannot be overstressed.

Chapter IV enlarges on the subject of economic drift, and deals with the construction of indices of American railroad bond yields which are free from it and also from mathematical drift or bias. This is done by relating a set of bond yields in a given year (or month) to the yields of the same bonds in the previous year (or month) by means of a linear equation. Mathematical bias in the process of chaining which is later to follow is eliminated by weighting the variables (which are taken as the logarithms of the yields) in inverse proportion to the squares of their standard deviations. It is for this reason that simple least squares regressions are replaced by equations of the form—

$$y_1 = a + \frac{\sigma_{y_1}}{\sigma_{y_0}} \cdot y_0$$

and the indices resulting from constructing a chain on an arbitrary but reasoned base with the aid of a set of such equations are termed by Dr. Macaulay "sigma lines."

This index is tentatively presented as a measure of the changing yield, not of American bonds as a whole but of American railroad bonds, which is free not only from mathematical bias, but also from economic drift. It is an extremely interesting index, particularly in its movement since 1929. After a fall through 1930 and the first half of 1931 and a precipitate rise, as in this country, at the end of 1931, the index falls away to a level far below that of the twenties. This movement is in accordance with that shown by a chain index, showing the geometric averages of the five bonds with the lowest yield (and therefore highest grade) in January of each year. An ordinary bond-yield index (and *a fortiori* one constructed from high-yielding bonds), after rising to great heights early in 1932, remains high, and by the end of 1935 is scarcely below the low peak of the twenties at the end of 1927. Here, then, is an example of how an apparently carefully constructed index of bond yields can reflect changes not in the yield of bonds of a given grade, but of the rapidly changing grade of the bonds that enter into the index resulting from rapidly worsening economic conditions. No such sharp divergence had previously occurred throughout the series (which go back to 1857) between the sigma index and a properly constructed index of yields of the usual type.

Chapter V introduces equities into the picture. Dr. Macaulay discusses the problems of weighting and averaging stock prices, and comes to the conclusion that an arithmetic average of prices weighted by the number of shares outstanding is the most useful form of index for most general purposes and for the special purposes he has in mind.

On comparing the price index of American railroad shares with an inverted index of American railroad bond yields, Dr. Macaulay finds little association in the trends of the two series, but considerable similarity in their cyclical behaviour. However, precisely the reverse is found when share prices are compared with an index of the degree of improvement or decline in railroad prosperity as measured by an index of the improvement or decline in the markets valuation of junior securities as compared with senior securities. Such an index is constructed by chaining the sigma ratios. Thus, starting in an initial period 1 given by $\frac{\sigma_1}{\sigma_0}$, the position in year n is given by the series of ratios—

$$\frac{\sigma_1}{\sigma_0} \cdot \frac{\sigma_2}{\sigma_1} \cdot \frac{\sigma_3}{\sigma_2} \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot \frac{\sigma_n}{\sigma_{n-1}}$$

This series would, of course, reduce to $\frac{\sigma_n}{\sigma_0}$ were it not for the fact that a changing set of bonds is used in making the comparisons from period to period.

The remainder of the book discusses the relation between interest rates and commodity prices and the timing, mainly over the trade cycle, of a number of economic series, such as money and interest rates, pig-iron production and bank clearings. The latter section is interesting and extremely well presented. The methods used are fully discussed in the author's earlier work *The Smoothing of Time Series*, to which reference is made in a brief appendix on the technique of smoothing.

The chapter on interest rates and commodity prices is also interesting, but more for its attitude to empirical research than for anything constructive that emerges. Dr. Macaulay criticizes—almost derides—Professor Fisher and Mr. Keynes for the insistence with which they have propounded the view that the persistent similarity between the movements of bond yields and commodity prices is so well established as to call for explanation. Much of the criticism of the methods used by these writers seems well founded, yet, when all is said and done, a considerable degree of association, possibly with interest rates lagged a quarter or two behind commodity prices, still exists. The author does little or nothing to explain why this should be so, though he brings forcible reasons against many of the explanations previously put forward. The reason for this failure seems simply that nowhere does Dr. Macaulay elaborate a theory of the factors which determine the rate of interest or, in the more general case, the family of rates of interest on assets of varying liquidity. This omission seems very strange, since with some such theory of interest and liquidity as has been developed by Mr. Keynes in his *General Theory*, many of Dr. Macaulay's difficulties would disappear without the need to overburden the idea of different sorts of errors in forecasting from one decade to another, or to resort to any curious reasoning about maladjustments from boom to slump in the anxiety to borrow or the willingness and ability to lend.

This omission, though perhaps unexpected, does not in any way detract from the value of the book. It is an empirical work of the first importance in a field remarkable for inattention to details of fact. In clarity it rivals Dr. Macaulay's earlier technical handbook on the smoothing of time series, and the appendices contain information of the greatest importance to students of the general fluctuations in trade. R. W. S.

5.—*National Income and Capital Formation, 1919–35. A preliminary Report.* By Simon Kuznets. National Bureau of Economic Research. New York, 1937. 12″ × 8½″. 86 + x pp. 6*s*. 6*d*.

This book is a preliminary report on the Measurement of National Income and Capital Formation which is part of a more detailed enquiry into Commodity Flow and Capital Formation undertaken by the National Bureau. It is partly based on earlier work appearing in the Bulletins and elsewhere. The National Income to be considered is taken as "the net value of commodities and services produced by the nation's economic system," and the material is so arranged as to attempt answers to five questions: How can the product of the nation's economic activity be defined? How large has the national product been since the War? In what part of the nation's economic system was it produced? How was its monetary equivalent distributed? and, How was the product utilized? The nine sections to the book give the first answers to these five gigantic questions.

The first section deals with definitions, and the scope and limitations of the estimates. The second gives annual figures of the total national income both in current prices and in 1929 prices. (The practice of expressing figures both in current and 1929 prices is continued throughout the book. It is very striking to notice the significant economic changes which would otherwise have been obscured but which have been brought out by the second figures.) National income is considered per head, per gainfully occupied person, and per "consuming unit." In America it emerged that income per consuming unit rose less and declined more than national income over the period. Section Three, on the distribution of national produce according to origin, shows a decline in the share of commodity-producing industries which appears to have been due to price changes. Section Four considers the allocation of income between employees' compensation, entrepreneurs' income, property income, and savings of enterprises in which the importance of net savings of enterprises as cause of variation in the national income totals is brought out. The fifth section develops an extremely interesting investigation. Shifts in total income payments between employees' compensation, entrepreneurs' income and property income were studied industry by industry to see what proportion of changes in the totals for industry as a whole were due to shifts within individual industries, or shifts from certain industries to others with higher or lower ratios. It appeared that the stability with rising tendency of wages and salaries was due to a shift to industries with a high proportion of employees' compensation. Employees' compensation actually declined in most industries. Entrepreneurs' income declined on both counts, and property income rose markedly.

The last sections, on capital formation and consumers' outlay, deal with definitions, allocation of income between the two, capital consumption and the composition of consumers' outlay. The latter was revealed as more stable than national income, while capital formation fluctuated very widely, net capital formation even becoming negative. The movements in types of capital formation —for example, relative decline of business inventories and growth of public construction—and the movements of consumers' outlay between durable, semi-durable and perishable goods are extremely interesting. Similar studies for Great Britain, were only information available, would be of the highest importance to British economists.

The book is completed by four excellent appendices. The first presents the detailed estimates on which the summary tables in the text are based. The second discusses differences between the Bureau's and the Department of Commerce's income estimates, and shows that when obvious differences of definition and method have been removed the discrepancies are negligible. The third discusses changes in previous estimates by the Bureau, and the fourth, comparability of estimates of capital formation with those of the national product.

It is impossible to withhold the most whole-hearted admiration from this book, which must rank as one of the foremost empirical works of our time. It is a short book which has been based on a staggering number of investigations, computations and estimates. Yet one can only marvel at the dexterity and economy of the arrangement, and the lucidity of the presentation. In the text itself the general economist will find that account of national product which will be most useful to him, arranged in such a way that the results are clear and can be easily applied to broad economic investigations. The detailed figures and certain information for special applications by students are compactly presented in the appendices.

R. W. S.

6.—*National Income of Sweden, 1861–1930.* By Erik Lindahl, Einar Dahlgren and Karin Koch. London: P. S. King. 1937. 8½″ × 5½″. Part I, xxi + 319 pp. 15*s.* Part II, xix + 631 pp. 20*s.*

In calculating the national income of a country, the kind of data available may determine whether a summation of the incomes of individuals, a record of the goods and services on which these incomes are spent, an aggregate of the payments made to factors of production, or some other, or mixed, conception of the proximate purpose of the calculation will dominate the work of the statisticians undertaking the task. The two volumes prepared for the Institute for Social Sciences of the University of Stockholm present, in considerable detail, estimates aimed, it would appear, at the third of these conceptions. Not unnaturally, an important part of the data utilized relate to kinds and quantities of goods produced, exported, and imported, not directly to the cost of productive services. Sweden is not one of the countries that carry out a periodic or occasional census of production, and the annual compilation of product-values covering the major part of its industrial production does not furnish figures corresponding to the net outputs familiar in our own recent industrial statistics. Arrangements to amend this defect are, it is understood, now in prospect. Special enquiries for other purposes have, however, provided material for dividing the product-values so as to separate the costs of materials, of depreciation, of personal services (wages and salaries), and "other costs and profits." Population censuses provide the numbers engaged in different activities with more or less precision, and the amounts and variations of wages and salaries for different kinds of work (the subject of a preceding publication of the Institute) form valuable material for tracing the course of the aggregate remuneration of the staffs of the groups of trades for which separate figures were desired. The more important of the special enquiries into industrial costs related to the years 1913, 1918, and 1926. Of these, 1918 is hardly a year in which costs would be expected to exhibit normal relations, and in some respects 1913 might be subject to like disqualification, but the statistician must make the best of such data as may be available if he is unable to set on foot extensive special enquiries. A good many sources of information were laid under contribution, and confirmation of some doubtful data was secured by relevant direct enquiry.

After the middle of the period dealt with—*i.e.* from 1896—the official data became more complete and their collection was better organized, and from 1913 onwards further important improvements affected the basic figures. The compilers of the volumes have, however, frequent occasion for lamenting the uncertainty of certain parts of the material put on record in those volumes. Particularly in respect of the period 1861–70 are these comments on the possible unreliability of the figures impressive.

The degree of detail presented in the tabular statements seems likely to have increased unduly the opportunities for presenting doubtful figures. Even the magnificence of the exhibition of income totals in considerable detail for every one of the 70 years of the period studied can hardly distract the attention of a critical student from this feature. The general trend of development might have been quite as truly traced with a considerable reduction in the number of years, or periods, for which calculations were carried out. The fact that information is lacking regarding changes in stocks, which appears to mean stocks of materials both raw and at various stages of adaptation, and of products at all stages short of readiness for delivery, may possibly affect the apparent relations of consecutive annual totals to a degree sufficient to render doubtful some conclusions regarding the nature of cyclical changes to which the long series of such figures offers an undoubted temptation.

A point of no little interest is that the calculated income aggregates include allowances not only for the services rendered by dwelling-houses, but also for those of all other durable consumers' goods. In the second half of the period the latter appear to account for a proportion increasing from about one-fifth to about one-third of the total charged to this account, with a notably higher proportion in the later war years and in the earlier post-war years. The services of dwelling-houses are taken at the gross rental less sums for maintenance and depreciation of the buildings based on fire insurance valuations. For other durable consumers' goods, a calculated amount for amortization of their estimated total value within the period of their durability is taken, current charges for maintenance being, presumably, included or ignored, though maintenance may affect the duration of their serviceability in some cases as careful handling may in others.

The procedure followed tempts to a comparison of the contribution of durable consumers' goods to national income when measured in accordance with the second and third of the two conceptions mentioned at the outset of this review. The material presented has clearly been difficult to handle, and appears insufficient for such a comparison. Whether the inclusion of the net output (in the sense indicated above) of the building and construction industry in any current year with the services in that year of the stock of dwelling accommodation accumulated from past activities of that industry, may involve some duplication, is not deemed to need discussion by the authors in presenting their data. In 1930 the maintenance and depreciation charge on residential building is taken as amounting to one-fourth of the net output of the industry, as entered in the tables.

A further point of interest is that unpaid domestic work is assessed at a money equivalent, and totals are given inclusive of these estimates, as well as exclusive of them. In the years from 1896 onwards, the unpaid work represented from one-sixth (in 1907) to one-fifth (in 1913) of the remainder of the calculated national income in the pre-war years, 1913 being the only year in which it exceeded 19 per cent. After 1922 the proportion fell gradually from 22 per cent. to 19 per cent. In the years 1914–22 it ranged between 19 and 22 per cent., except in 1920 and 1921, when it was higher, by 2 per cent. and 1 per cent. respectively, than in any other year of the series. The comparatively stable proportion of this element, generally omitted from calculations of national income, to the remainder is striking, but whether it has significance may be doubted.

According to the tables in these volumes, the national income of Sweden, not including household (and other) services rendered without stipulated remuneration, was more than ten times as great in the decennium 1921–30 than in the decennium 1861–70, and comparing the periods 1896–1913 and 1923–30 previously referred to, there was a nominal increase of the annual average in the proportion of about 4 to 13. Per head of the population it averaged, in the years 1923–30, the equivalent of about £70 a year, and exceeded the computed consumption in Sweden in that period by about 9 per cent. In the eighteen years to 1913, a like calculation shows an average of somewhat over 5 per cent. The peculiar conditions of the War raised the proportion of saving to income, as thus calculated, to as high as 1 in 6 in the years 1916–18. A. W. F.

7.—*The Economic Policy of France.* By The Hon. George Peel. London: Macmillan, 1937. $8\frac{3}{4}'' \times 5\frac{1}{2}''$. viii + 242 pp. 8*s.* 6*d.*

The disorder in French governmental finances was connected with antiquated methods of taxation preserved from revolutionary times, but it became acute when a policy of imperialist expansion was adopted, the profligate expenditure on which was concealed by borrowing and a complicated series of budget-shufflings. The armaments race against Germany added to the burden, and when war came it was financed by loans and not by taxation. Reconstruction of the devastated areas produced a post-war boom, based on loans lightheartedly raised in the belief that Germany would pay and expended with little regard to economy. When the golden fountain of reparations ceased to flow disaster came, but the heroic measures of Poincaré restored the national finances. It could be written of the income tax that "owing to fraud, equality in taxation no longer exists," but still under the stern man from Lorraine the French taxpayer submitted to a drastic rise in taxation. Even more important was the devaluation of the franc, which Poincaré stabilized at about a fifth of the pre-war parity. So, says Mr. Peel, "at the hour of the final departure of Poincaré, all seemed well with the economic policy of France."

But between the middle of 1929 and the spring of 1932 there were ten transient Ministries and "swift deterioration in the economic policy of France was an inevitable accompaniment of these unstable conditions," which were intensified by the failure of reparations, the burden of the debts to Britain and the United States, the extravagance of the Chamber, and the world crisis which developed in 1931. The advantages of the cheaper franc were lost when other countries devalued their currencies, the Affaire Stavinsky shook the national morale, speculation in the franc "had dived deep into the pockets, and had bitten still more deeply into the souls of men." Democratic control was fitfully surrendered to a system of "decree-laws" which culminated in the 549 promulgated by the Laval Ministry in 1935–36. Prodigious as this output was it neither relieved taxation nor made its distribution more just, a large part of the economics proposed was mere postponement of expenditure, the policy of deflation proved disastrous, and "the rats of speculation and gambling were still behind the arras." Such was the inheritance of prodigality and disorder which fell to M. Blum, whose "experiment" was a gallant but ill-fated attempt to overtake the arrears of social reform in one comprehensive action with too little regard for financial consequences. So Casca Caillaux struck and slew. "During the last thirty years the economic policy of France has been, in substance, on a war footing." "The central truth is that the fixed capital of France, so splendidly administered otherwise, cannot function duly with her floating capital out of gear." Therefore there is need for "higher technical efficiency" and "greater consistency" in economic policy—so concludes Mr. Peel.

This is a brilliant book—see the duel between Caillaux and Blum or the identification of Caillaux with Disraeli's Sidonia. No difficulties are shirked, yet the tangled financial web is skilfully unravelled. It is a book for all financiers and politicians. H. W. M.

8.—*Practice and Finance of Foreign Trade.* By W. W. Syrett. London: Macmillan, 1938. 7¾″ × 5¼″. 233 pp. *7s. 6d.*

This book, which was awarded the "Institute Prize" by the Institute of Bankers in 1937, furnishes a clear exposition of the various methods of financing our international trade. The book explains the various terms used, and reproduces several credit instruments used by bankers and merchants in financing imports and exports.

There are one or two points which might usefully be expanded in the next edition. On page 13 the right of stoppage *in transitu* is dealt with in regard to goods sold on c.i.f. terms, but it is not made clear if this right still exists once the bill of lading has passed into the hands of the buyer. In two or three places in the book (pages 48, 187, and 192) the author seems to suggest that all c.i.f. contracts are on documents against payment basis, although elsewhere he deals with documents against acceptance. But merchants enter into many c.i.f. transactions on an open-credit basis and the term c.i.f. has no connection with, nor does it imply, any special terms of payment. This is not always made quite clear by the author, probably because most c.i.f. transactions which are financed by banks are on a cash against documents basis. This, however, is a small point, and the book is one which should be carefully read and studied by any young man commencing a career in a merchant's office or a bank connected with international trade.

The second half of the book, which deals with the credit risk, the exchange and transfer risk, forward exchange, exchange restrictions, and clearings and barter arrangements, should have a much wider appeal. There is a useful chapter explaining and commending the increasing help which the Government is giving to exporters through the Export Credits Guarantee Department, both in respect of the risks of bad debts and of the newer development in insuring against impediments in the transfer of money by foreign debtors to British creditors. The mechanism of forward exchange transactions is explained, and the difficulties which merchants may encounter in covering their exchange forward under certain conditions. The exchange restrictions existing in various countries, clearing and barter agreements are concisely although necessarily somewhat sketchily set out, and for fuller information the reader is referred by the author to the relevant publications of H.M. Stationery Office.

Mr. Syrett places clearly before his readers the new difficulties with which all international traders are faced since the beginning of the present decade, difficulties which are quite distinct from those caused by tariffs and quotas, for they are all connected with the financing of business, and in the main resolve themselves into questions of credit in some form or other. B. E.

9.—*The Future of British Railways.* By W. J. Stevens. Foreword by Sir Josiah Stamp, G.C.B., G.B.E. London: P. S. King and Son, Ltd., 1938. 7½″ × 5″. xiii + 101 pp. 5*s.* net.

Written primarily from the point of view of the stockholder, this short work reviews the varying fortunes of British Railways since the Railways Act of 1921, and examines the present position in its bearing on future development and prospects. Recent influences, more particularly the general expansion of traffic, the settlement of the local rating and wages questions, and the increase in rates and charges, have tended to steady the compass, and the author suggests that the course should now be set towards the attainment of the "standard revenue" envisaged by the 1921 Act. In this, he is encouraged by the judgment of the Railway Rates Tribunal last year, that the legislature, in passing the Railways Act, "regarded the realization of the standard revenue to be in the public interest." That the net-revenue for 1937 was some £13 million below the standard of £51 million indicates that the end is by no means in sight.

Sir Josiah Stamp, in a brief but comprehensive foreword, surveys the principal factors, and calls particular attention to the position of the stockholders, many of whom have received no return for several years. He points out that in 1936 £78 million remained unremunerated, and it may be added that the improvement in 1937 left the same amount (comprising the ordinary stock of the London and North Eastern Company) still without return.

The earlier chapters are mainly descriptive of the relations between the railways, their staffs, the State and the public. As regards the State, it is suggested that the grouping of the companies was a bargain, accepted as an alternative to unification or nationalization, but the increasing advocacy of these or similar measures receives no mention. In the author's view, progress can best be achieved by legislation directed towards the further co-ordination of road and rail, with particular reference to goods transport. He urges the Government to implement, without delay, the recommendations of the Transport Advisory Council as to the fixation and publication of minimum rates in the road-transport industry. That the road–rail controversy has been intensified by discriminating conditions of competition may be admitted, but the author's contention that these conditions are at the root of the failure to earn the standard revenue surely ignores the disastrous effects of the general depression. A chapter on "Points for Investors" emphasizes the progress made in the reorganization necessitated by the grouping and the great advance in technical efficiency. Four chapters review the position of the individual companies, and an appendix gives a number of statistical tables, including eight years' financial results. It is apparent that the financial equilibrium, even in the worst years, has been disturbed to a much smaller extent than might have been expected. The author considers that the major risks of the new era have fallen upon the junior stockholders, and concludes with a plea for more sympathetic consideration by the Government of the road–rail problem and a policy of greater co-operation between the owners, the boards and the staffs. Some suggestions as to how this might be achieved and a greater appreciation of the problem as a whole would not have weakened his argument. H. G. L.

10.—*Living on a Moderate Income.* By E. H. Huntington and M. G. Luck. 9½″ × 6¼″. xiv + 206 pp. Oxford University Press: Humphrey Milford. 1937. 8*s*. 6*d*. net.

This book is issued under the auspices of the Heller Committee for Research in Social Economics, of the University of California, and the American Council of the Institute of Pacific Relations.

It gives the results of an enquiry into income and expenditure among families of street-car workers and clerks in the San Francisco East Bay region, with the object of indicating the standard of living enjoyed by two groups of "moderately well-to-do workers." For the car-workers' families to qualify for inclusion, the head had to be regularly employed and the family had to consist of at least a husband and a wife. The clerks' families were subject to more severe qualifications. The man had to be married and living with his wife, and to have at least one dependent child; he must have been employed in San Francisco for not less than eleven months in his actual job; his salary had to be between $1,200 and $2,500, and the total family income less than $3,500; finally he had to be a householder. Income and expenditure were recorded in considerable detail for the year 1933 in respect of 102 car-workers' families and 98 clerks' families fulfilling these conditions. The car-workers' families with one dependent child, numbering 74, were analysed separately to provide comparison with the clerks' families. The averages for the 74 families, however, were almost identical with those of all the 102 car-workers' families.

The average number of persons in the car-workers' families was 4·6, and in the clerks' families, 3·9. The average family expenditure of both clerks and carmen, at rather more than $2,200 and $1,875 respectively, was almost exactly 10 per cent. in excess of income. That 70 per cent. of both kinds of family overspent their income is taken to indicate an attempt to live on a higher standard than the income would permit. It should be mentioned that where the discrepancy between income and expenditure exceeded $100 for the year, the details were further examined and checked.

In the clerks' families, 65 per cent. of income was devoted to food (26 per cent.), clothing (10 per cent.), and shelter (29 per cent.). The comparable figure for the car-workers' families was 68 per cent.—food 32 per cent., clothing 9 per cent. and shelter 27 per cent. On these three items together, the results were much the same for both kinds of family, but whereas the clerks spent relatively less on food than the others, somewhat more was spent on clothes and shelter. The details given for particular foodstuffs show little difference between clerks and car-workers; the latter spent slightly more on eggs, bread and groceries, and less on meat, milk and fruit. The remaining third of the expenditure went very largely to insurance, saving, motor cars (kept by 75 per cent. of the car-workers and 63 per cent. of the clerks), medical care and leisure. Other miscellaneous items, such as gifts, fares and education, accounted for slightly more than 10 per cent. of the total expenditure.

In addition to results based on family averages, expenditure is also shown "per consumption unit," in order to eliminate the effect of the difference in the average size of family. The unit used for this purpose is complicated, and combines food expenditure by age and sex, allowance for absence from home, and, thirdly, partial allowance for boarders, visitors and wage-earning children. The first of these three items gives rise to a male equivalent scale (based on food only) calculated to three decimal places; such refinement appears difficult to justify.

This investigation gives the impression of having been carefully done, although the excess of expenditure over income would probably leave the English social-survey worker rather uneasy. He might, however, be inclined to associate this result with the process of asking families in January 1934 for their detailed expenditure during the previous twelve months. The book is certainly an interesting contribution to family budget literature. R. F. G.

11.—*Das Bevölkerungsproblem und seine Auswirkung in der neuen deutschen Steuerreform.* By Karl Barth. (Würzburger Staatswissenschaftliche Abhandlungen, Reihe A, Heft 5). Leipzig: Hans Buske, 1936. 9″ × 6″. 158 pp. *Rm.* 4.50.

At the present time there is a spate of German books attempting to indicate to the intelligent public the major facts of the population problem. Dr. Barth has, however, not simply produced another book to join the spate, but a relatively impartial and interesting contribution to the general population question. The first section deals with population theories, and also contains some references to previous population policies. It is rather a pity that, with the exception of the laws of Augustus, so little attention is paid to these earlier policies. Many of the seventeenth- and eighteenth-century attempts to stimulate population growth are interesting, not only in themselves but as forerunners of the policies now being carried out in so many European states.

The largest section of the book is concerned with a general analysis of the population position in Germany, and here the author mainly makes use of the work of Burgdörfer. He does not, however, point out that Burgdörfer's "refined birth rate" is not an accurate index of the reproductivity of a population, except when the potentially fertile females aged 15 to 49 show the same age-distribution among themselves as in the life table population for the particular year. Since this exception is rarely found in practice, Burgdörfer's index is only approximately correct. By contrast, the section on the new German tax reform is relatively small. A useful bibliography is given at the end of the book. D. V. G.

12.—*Other New Publications* *

Fairplay's Annual Summary of British Shipping Finance. Compiled by "Fairplay." *Weekly Shipping Journal*, 51–6, Palmerston House, E.C.2. 8½″ × 5½″. 588 pp. 21s.

[We have lately received the fourteenth edition of this valuable publication, which contains the accounts of the leading shipping companies dealt with regularly in *Fairplay Weekly Shipping Journal* supplemented by the figures of other shipping companies and the names of the principal shareholders. This year a summary is given, whenever possible, of the last four balance sheets issued by shipping companies, also particulars of many which were not dealt with last year, and the amount of liens, if any.]

Istituto Centrale di Statistica del Regno d'Italia. Censimento Industriale e Commerciale 1937–1940. Relazione per la Commissione Generale: Criteri, metodi e norme per l'esecuzione del Censimento Industriale. Studio sul Concetto di Valore Aggiunto della Produzione. 10½″ × 7½″. 128 pp. Roma, 1937.

[This brochure consists mainly of a very full discussion of the principles laid down and the methods adopted for taking the industrial and commercial census now proceeding in Italy, including the method to be used in arriving at the aggregate value of the production. The provisions formulated are intended to serve as a basis for the similar censuses which are to be held in future at 10-year intervals. One of the main points in which the Italian census differs from those of other countries is the spreading over four years, the years being those between a quinquennial population census year and the next. The enquiries are "staggered," so that in taking the present census, 1937 is allotted to the fishing and other food industries, 1938 to mining, timber, building, paper, leather, textiles, clothing, etc., 1939 to miscellaneous industries and transport, 1940 to commercial and distributive undertakings. It was decided that the advantages of this arrangement, in allowing more time for the careful collection and treatment of data, outweighed the obvious disadvantage of the difficulty of presenting an accurate picture of the whole position, especially in periods of change. The report is prefaced by a brief account of the four previous enquiries (the industrial censuses of 1878, 1883, and 1911, and the industrial and commercial census of 1927) the results of which were far from adequate. The Appendix contains facsimiles of the schedules used in the present and the earlier censuses and of some of those used in other countries.]

Johns Hopkins University. Collected Papers from the Department of Biology of the School of Hygiene and Public Health. Baltimore, 1937. 9¾″ × 6¾″. Vol. XIV.

[This volume contains twenty-four papers reprinted from various Journals: *Human Biology, American Naturalist, American Journal of Hygiene,*

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* *See also* Additions to Library, p. 661.

Journals of the American Statistical Association, American Medical Association, etc. Part I, General Biology, contains one by Professor Raymond Pearl, " Biological Principles Affecting Populations: Human and Other "; four by Thomas Park: Experimental Studies of Insect Populations: The Relation of Environmental Conditioning to the Decline of *Tribolium confusum* Populations (written in collaboration with Nancy Woollcott); The Inheritance of the Nutation "Pearl" in the Flour Beetle, *Tribolium castaneum* Herbst; Note on the Occurrence of a Pupal Abnormality in the Flour Beetle *Tribolium confusum* Duval; The Culture of *Tribolium confusum* Duval; and one by William Burrows, The Nutritional Requirements of Bacteria. In Part II, Human Biology, Professor Pearl contributes eight: Karl Pearson, 1857–1936; Constitution et Santé; the Weight of Parathyroids; Biological Factors in Fertility; Potential and Actual Reproductive Performance in Man; Variation in Parity of Women Bearing Children in the U.S. Birth Registration Area in 1930; and two on Fertility and Contraception in New York and Chicago. Antonio Ciocco contributes four, two concerned with height of body in adults and two with audiometric studies on school children. Two others, on skin irritation and cancer, are by Sigismund Peller (one written in collaboration with C. S. Stephenson). The last three are bibliographical lists, " Recent Literature Useful in the Study of Human Biology."]

Leake (P. D.). Balance Sheet Values: the Limitations of Industrial Accounting. 2nd ed. London: Gee and Co., 1938. $8\frac{3}{4}'' \times 5\frac{1}{2}''$. 75 pp. 4*s.* 6*d.*

[In his little treatise on balance-sheet values, published in 1929, Mr. Leake urged the need for the development of more scientific methods in industrial accounting, and in particular for a more exact measurement of the annual profit and loss on production. The book has now been expanded, as the new title indicates, to include a fuller discussion of " the inevitable but still commonly unrecognised " limitations of industrial accounting, which he defines as the " science of recording the history of profit-seeking transactions in useful services and tangible things." The case for the elimination of all intangible values, summarily stated in the earlier edition, is here argued in some detail. The final section contains suggestions for the amendment of company law in accordance with the principles of accounting laid down by the author.]

Liverpool University. Social Science Department, Statistics Division. Overlapping and Co-ordination. An examination of the Liverpool Register of Mutual Assistance. University of Liverpool Press, 1938. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. 39 pp. 1*s.*

[In Liverpool, while a great many relief agencies exist, there is no central case paper department and no very precise division of functions. The chief object of the Register, whose foundation (in 1910), function, scope and administration are described here by Mr. George Gray Thomson of the University Social Science Department, is to prevent overlapping in the granting of relief and to make all help as effective as possible by arranging for a continuous exchange of information between the various organizations. The Register also ensures that each body is kept reliably informed of the assistance given by other bodies to families in which they are jointly interested, and thus forms in itself a much welcomed form of co-operation. There are at present 64 names on the Register's list, and the number continues to increase. A complete list is given in an appendix; it includes such organizations as the Prisoners of War Fund, the Police Aided Clothing Association, the Merseyside Hospitals After-Care Department, and the Child Welfare Society. " It is hoped," to quote the author's last sentence " that as a result of this report the Register will be made an instrument of more extensive co-operation between the voluntary societies and those who are directing the public social services in facing the social problems of to-day and framing a policy for the future."]

Waugh (Albert E.). Elements of Statistical Method. London: McGraw-Hill Publishing Co., 1938. 9″ × 6″. xv + 381 pp. *21s.*

[As the author explains in his preface, this book is for the beginner in the field of statistics who has yet to learn "what it is all about." Within these pages are explanations of the various methods used in statistical analysis, grouping data in tabular form, measuring central tendencies where such tendencies are of interest, the various kinds of average, measures of dispersion, the normal curve, after some elementary probability, the Poisson series, measurements of skewness and kurtosis, something on sampling. Then follows an account of various methods of analysing "historical data," simple linear correlation, simple curvilinear correlation, multiple correlation. Later comes a chapter on Tabular and Graphical Presentation and the Collection and Analysis of Data. Perhaps these last two chapters should come at the beginning of the book. Throughout, the book is well illustrated at every stage with examples, and each chapter has its examples for exercise.

The book is well produced and should be useful for the student who wishes to get a general acquaintance with statistical methods and their applicability to different fields. The examples illustrating the methods are drawn from a variety of sources.]

Wilson (Sir Arnold) and *Levy (Professor Herman).* Burial Reform and Funeral Costs. London, New York, and Toronto: Oxford University Press, 1938. 9¾″ × 6½″. xv + 248 pp. *12s. 6d.*

[One person in eleven who dies in Greater London is buried as a pauper by a Public Assistance Committee at the expense of the rates, and the proportion of persons buried in this way is not decreasing—this although there exist to-day more than eighty million insurance policies against the expenses of burials and funerals. One purpose of this enquiry was to ascertain what these costs are, if they can be reduced, and whether they are being enhanced for commercial reasons by encouraging extravagance and needless display or by high cemetery charges. The first part of the book includes an historical account of funeral customs from the earliest times, the first reforms, and the beginning of the cremation movement; the second deals with the present economic and social habits of burial; and the third with the legal aspect. The fourth and last part is concerned with the way to reform. Among the proposals made are: that there should be a full and impartial official enquiry into the whole question of the disposal of the dead (this would be the first of its kind since 1848) with powers to obtain full evidence from appropriate ministries, burial authorities, undertakers, etc.; that death benefit should become an automatic benefit under the National Health Insurance Acts (alternatively, it is suggested that burial authorities might emulate cremation societies by contracting to meet funeral expenses on an agreed scale against monthly or quarterly premiums); the establishment by law of a Commissioner for the Disposal of the Dead. The book contains several appendices including: Differences in Cemetery Fees in Twenty-five London Cemeteries; Standard Table of Fees prescribed for England by the Ecclesiastical Commissioners; Draft bill "to provide for the Registration of Funeral Directors, and for purposes connected therewith" (not yet introduced into Parliament); Rules of National Association of Funeral Directors (London Area Federation) 1936. There is also an index.]

STATISTICAL NOTES

(1) British Official Statistics

On page 639 we give our usual table summarizing the *oversea trade* of the United Kingdom for the years ended June 1937 and 1938. The rapid increase in the excess of imports over exports last year continued during the first quarter of this year, but since then there has been a decline month by month in the adverse balance. At the end of the first quarter the excess of imports had risen by £18·5 million, but this rise was reduced by £7·2 million in the second quarter, this being the first reduction in the adverse balance since the third quarter of 1935. With a view to eliminating the disturbing effect of the incidence of the Easter and Whitsun holidays, the months are taken in pairs in the following table :—

	Retained Imports		Exports		Excess of Imports over Exports	
	1937	1938	1937	1938	1937	1938
			In million £			
January–February ...	135·3	150·3	77·7	78·7	57·6	71·6
March–April	151·9	148·1	86·5	79·4	65·4	68·7
May–June	156·8	139·8	87·1	75·1	69·7	64·7

It will be seen that whereas in the first half of last year there was a general increase in imports and exports—this being contrary to the normal seasonal trend and being due in part to rising prices—there has this year been a marked decline in retained imports, the decline in exports being less considerable.

The volume of retained *imports* was the same in the first half of this year as a year earlier, a rise in the first quarter being followed by a fall in the second. Average values of imports reached a peak in the third quarter of last year, the fall between the first and second quarters of this year being 4 per cent. For exports the peak in average values was not reached until the first quarter of this year, the subsequent fall being 2 per cent.; as a result average values of exports but not of imports are still higher than they were last year. Exports in the first half of this year were 12 per cent. smaller in volume than a year ago. Allowing for seasonal movements and for price changes, exports during recent months would appear to be at about the same level as earlier in the year.

Total imports during the first half of 1938 were valued at

£469,618,000, or £14,483,000 less than a year earlier, there having been an increase during each of the first three months and a decrease, aggregating £29,759,000, in the following three months. Re-exports amounted to £32,848,000, or £7,705,000 less than in the first half of 1937, the decline being common to each month. Over three-quarters of the decline was in respect of three groups, there being falls exceeding £2 million for rubber and undressed hides and skins and one of £1·4 million for wool; the last mentioned was due wholly to lower prices, the quantity re-exported being larger than in the first half of either 1936 or 1937.

The value of retained imports of food, drink and tobacco during the first half of the year amounted to £204,972,000, being £11,403,000 more than a year earlier. The increase in this class is still continuing, the decline in imports noted above being solely in respect of raw materials and manufactured articles. Dairy produce has shown the largest rise—over £7 million—mainly as a result of higher prices of butter, cheese and eggs, though imports of each of these, particularly eggs, have been greater in quantity than a year ago. Retained imports of tobacco have risen from £4½ million to £8½ million, the imports this year being considerably larger than normal, presumably as a result of the low imports and consequent depletion of stocks last year. The rate of consumption has never been higher. The increase in the value of imported meat was nearly £3½ million. Of this, £2 million was in respect of beef, mainly as a result of higher prices, and over £1 million in respect of bacon, notwithstanding a small decline in quantity. Mutton and lamb showed no appreciable change in either quantity or value. As against these increases there was a decline of over £3 million in respect of grain and flour, imports of which were exceptionally high in value a year ago. With a negligible decline in quantity, retained imports of wheat fell by £3 million in value. Other changes were of less importance, but it may be noted that imports of grain and flour from the United States rose from £393,000 to the very exceptional figure of £10,968,000, and that imports from the Argentine fell from £16,469,000 to £4,162,000. Retained imports of tea rose by over £2 million, due to an increase in the quantity imported, while for sugar the value fell by over £1 million, wholly as a result of lower prices.

Retained imports of raw materials fell by £12,705,000 to £116,855,000, the decline being in the second quarter, and due rather to the high prices of a year ago than to small imports this year. In fact the calculation made by the Board of Trade shows a decrease in volume of only 1 per cent. For the second quarter there was a fall of 7 per cent. both in average values and in volume. The largest declines were recorded for cotton and wool—£9,758,000 and £5,563,000 respectively. The decline in cotton was due in part to lower prices, but the quantity fell by 148 million lb. (19 per cent.), while for wool, prices accounted for the whole of the fall, there being a small increase in the quantity retained. Imports of other textiles, with the exception of silk which was imported in record quantity, were less than a year ago. There were, on the other hand, increases of £4,329,000 for rubber and £3,080,000 for iron ore and scrap, though with the cessation of the special imports of scrap from the United States the latter group has recently shown a decline. The increase in rubber was due to the larger quantity imported, prices being lower than a year ago. Imports of iron ore were the highest for any comparable period since the first half of 1920.

A decrease from £117,980,000 to £112,294,000 was recorded in retained imports of articles wholly or mainly manufactured. For the first quarter there was a rise of £6,895,000 and for the second a fall of £12,581,000, the latter being common to all but two of the individual groups. For the six months there was a marked increase of nearly £4 million in the value of iron and steel imported, the quantity being over 50 per cent. higher than a year ago, but for the second quarter there was a decline from 361,000 to 178,000 tons, following the reimposition of the iron and steel duties at the higher rate and the removal of pig iron from the Free List. Lower prices caused a fall of over £5 million in retained imports of non-ferrous metals. The quantity of machinery imported was slightly below the record figure for the first half of 1937. Imports of motor-cars were comparatively small in the second quarter, but in the first three months there were considerable imports of German cars. Retained imports of refined petroleum were the highest ever recorded for the first half of the year, largely owing to increased imports of fuel oil.

Exports of United Kingdom goods were valued at £233,194,000 in the first half of this year, being £18,021,000 less than a year earlier; the decline was mainly in the second quarter, but, as indicated above, this was due more to rising exports a year ago than to falling exports this year. Of the decline of £1,743,000 for food, drink and tobacco, £755,000 was due to smaller exports of spirits. Exports of raw materials declined by £4,304,000 from the comparatively high figure of last year, but for coal there was a rise of £1,630,000. The latter was the result solely of a substantial increase in the average value to a figure (20/11*d*. per ton) higher than for any year since 1924. The quantity exported declined from 18·6 to 17·5 million tons, mainly due to a reduction of 1,012,000 tons in exports to France. There was a further improvement of 339,000 tons in exports to Italy, this occurring wholly in the first quarter. Practically all the other groups of raw materials showed declines in value;

that for raw wool, etc. (£2,618,000), was particularly large, over half being due to reduced purchases by the United States. Exports of manufactured goods decreased from £195,031,000 to £183,520,000, there being very marked declines for each of the textile groups—cotton goods (£8,404,000), woollen and worsted goods (£4,329,000) and other descriptions (£2,525,000). Exports of iron and steel goods decreased by about £1 million and non-ferrous metals by £1½ million, but there were substantial increases for machinery (£6,198,000) and vehicles (£3,336,000). The latter and rubber manufactures were the only three groups for which the value of exports during the second quarter was higher than a year earlier.

Exports of iron and steel goods decreased from 1,350,000 tons to 1,011,000 tons, two-thirds of the decline being in the second quarter. The decline affected all the principal classes, exceeding 50 per cent. for galvanized sheets. Exports of machinery rose from 207,000 tons to 240,000 tons, the increase in the first quarter being 26,000 tons and in the second 7,000 tons. Textile machinery, machine tools, electrical machinery, paper-making machinery, and cranes, hoists, etc., all showed substantial increases. Exports of motor-cars and chassis just exceeded those of a year earlier, and constituted a new record for the first half of the year. The value of aircraft exported was more than double that in the comparable period of any earlier year.

A year ago it was said that, with the important exception of cotton piece-goods, exports of textiles in general were larger than in the first half of any year since 1929. This year there has been a very marked all-round decline. For cotton piece-goods the fall amounted to 276 million square yards (28 per cent.), as a result mainly of abnormally low exports to British and French West Africa and Switzerland and the continued reduction in exports to India, though few markets took more than a year ago. The following were the declines recorded for the principal other descriptions of textiles: cotton yarns, 28 per cent.; woollen and worsted yarns, 29 per cent.; woollen and worsted tissues, 26 per cent.; artificial silk tissues, 17 per cent.; linen piece-goods, 45 per cent.; jute piece-goods, 52 per cent. With comparatively few exceptions, exports of the other important descriptions of manufactured goods were less than a year ago, but it must be remembered that export trade in the first half of last year was rather exceptionally flourishing.

Imports of bullion and specie exceeded exports in each month of this year. Imports during the six months amounted to £148·0 million and exports to £68·2 million, the import excess of £79·8 million comparing with £30·6 million in the first half of last year and £59·4 million in the second half. The inward and outward movements of silver were both exceptional, in each case exceeding

Movements and Classes	Twelve Months ended June, 1937	Twelve Months ended June, 1938	Increase (+) or Decrease (−)
Imports, c.i.f.—	£'000	£'000	£'000
Food, drink and tobacco	402,082	443,609	(+) 41,527
Raw materials and articles mainly unmanufactured	280,653	295,976	(+) 15,323
Articles wholly or mainly manufactured	240,707	268,279	(+) 27,572
Other articles	5,791	6,717	(+) 926
Total Imports ...	929,233	1,014,581	(+) 85,348
Exports, f.o.b.—			
United Kingdom Produce and Manufactures—			
Food, drink and tobacco	37,770	37,038	(−) 732
Raw materials and articles mainly unmanufactured	59,063	60,348	(+) 1,285
Articles wholly or mainly manufactured	373,896	393,328	(+) 19,432
Other articles	13,199	12,860	(−) 339
Imported Merchandise—			
Food, drink and tobacco	12,214	13,015	(+) 801
Raw materials and articles mainly unmanufactured	38,078	30,250	(−) 7,828
Articles wholly or mainly manufactured	18,188	23,423	(+) 5,235
Other articles	435	773	(+) 338
Total Exports ...	552,843	571,035	(+) 18,192
Bullion and Specie—			
Imports	397,671	291,178	(−) 106,493
Exports	207,828	151,972	(−) 55,856

Movements of Shipping in the Foreign Trade—	Number of Vessels	Thousand Tons Net	Number of Vessels	Thousand Tons Net	Number of Vessels	Thousand Tons Net
Entered with cargoes—						
British	24,542	38,883	24,943	39,422	(+) 401	(+) 539
Foreign	26,676	30,070	27,965	31,074	(+)1,289	(+)1,004
Total entered ...	51,218	68,953	52,908	70,496	(+)1,690	(+)1,543
Cleared with cargoes—						
British	30,168	35,134	30,413	35,517	(+) 245	(+) 383
Foreign	22,450	23,973	22,309	24,516	(−) 141	(+) 543
Total cleared ...	52,618	59,107	52,722	60,033	(+) 104	(+) 926

£14 million, nearly £12 million of which came from Hong Kong and China, while exports to the United States amounted to £12·6 million.

During the three months March to May, 1938, general *wholesale prices* continued to fall and the Board of Trade index number (1930 = 100), which was 105·8 in February 1938, had fallen by May to 102·0 or nearly 3·6 per cent. In July 1937 general wholesale prices had reached their highest since the depression of 1931–34. Since that month there has been a fairly steady decline amounting altogether to about 8·5 per cent. The decline has been chiefly in industrial materials and manufactures, the index number for which groups has fallen from 116·1 to 102·7 or 11·5 per cent. The fall was still greater in basic materials alone, where it amounted to nearly 30 per cent. As was to be expected, the fall has been least in articles of food (2·4 per cent.), the increased duty on tea and seasonal fluctuations somewhat affecting the trend. Iron and steel prices, which continued to rise up to January 1938, fell away slightly in February, and prices in May 1938 were 1·6 per cent. below those for January. They are, however, still nearly 39 per cent. above the average for 1930, and nearly 53 per cent. above the low prices obtaining in June to September 1932. As compared with twelve months ago, the index number for all articles has fallen 7·9 per cent. and that for articles other than food 11 per cent. For basic materials the decline has amounted to 31·2 per cent. Prices for building materials have shown little change, although there has been a slight downward movement during the present year. As compared with a year ago, there has been a rise in most foodstuffs except cereals, British mutton, potatoes and cocoa, the fall in the last-named article amounting to over 32 per cent. Non-ferrous metals have also declined from the abnormally high prices obtaining in the spring of 1937, and the prices of practically all textiles have fallen, as also have those of hides and skins.

The Board of Trade index numbers of wholesale prices for the last four months are given below:—

(Averages for the year 1930 = 100)

Date	Total Food	Total not Food	All Articles	Basic Materials	Intermediate Products	Manufactured Articles	Building Materials
Feb., 1938	103·4	106·9	105·8	100·2	106·4	113·4	104·7
Mar. ,,	100·7	105·7	104·1	96·7	105·8	113·2	104·5
Apl. ,,	100·3	104·4	103·1	93·8	105·2	112·7	104·5
May ,,	100·4	102·7	102·0	90·5	104·8	111·9	104·1
May 1937	*101·8*	*115·4*	*110·7*	*131·6*	*110·9*	*113·6*	*104·0*
,, 1936	*88·2*	*93·8*	*91·9*	*96·1*	*91·1*	*96·9*	*95·0*

The figures for certain of the other British index numbers of wholesale prices and the official index numbers of Germany, France, and the United States are given below for comparison.

Date	Board of Trade (1930 = 100)	*Economist* (1927 = 100)	*Statist* (1866–77 = 100)	*The Times* (1913 = 100)	France (*Stat. Generale*) (1913 = 100)	Germany (*Stat. Reichsamt*) (1913 = 100)	U.S.A. (Bureau of Labor) (1926 = 100)
Feb., 1938	105·8	75·6	96·4	119·8	631	105·7	79·8
Mar. ,,	104[illegible]	74·1	94·2	117·6	634	105·8	79·7
Apl. ,,	103·1	73·3	93·5	118·1	643	105·6	78·7
May ,,	102·0	72·2	91·4	116·0	654	105·5	78·0

Over the four months all the index numbers except that of France show a decline. The French rise (rather less than 4 per cent.) is no doubt connected with the devaluation of the franc.

During the three months March to May 1938 there was a slight fall in *retail prices* of articles of working class consumption. There were decreases in the prices of flour, bread and milk, which were offset to a great extent by the increase in the price of tea owing to the increased duty and by advances in the price of butter and potatoes. Seasonal influences were the cause of the fall in milk, and the advance in potatoes was due to the marketing of the new crop. The Ministry of Labour total index number of retail prices, which stood at 156 at the beginning of March, dropped to 154 at the beginning of April, rose again to 156 at the end of that month and fell to 155 at June 1st. The index numbers for food only fell from 140 to 138 during the three months. There appears to have been some slight appreciation in rents over the last two months. The index numbers for the last four months are given below, the prices at July 1914 being taken as 100.

	Mar. 1st, 1938	Apl. 1st, 1938	Apl. 30th, 1938	June 1st, 1938	June 1st, 1937	June 1st, 1936
Food Prices	140	137	139	138	136	126
All Items (food, rent, clothing, fuel, etc.)	156	154	156	155	152	144
All Items (a year earlier)	151	151	152	152	144	140

It will be seen that retail prices are still somewhat (about 2 per cent.) above the level of 1937 and about 7·6 per cent. above the level of 1936.

Employment during the period February 14th to April 4th, 1938, improved slightly, but not to the extent usual in the spring period, and the rate of unemployment in the insured trades in Great Britain and Northern Ireland only declined from 13·2 to 12·9 per cent. During the following statistical period ending on May 16th employment again declined slightly, and at the end of that period the rate was 13·0 per cent., compared with 10·7 per cent. at May 24th, 1937. There was over the three months some appreciable improvement in seasonal industries (building, hotel service, etc.), and the usual slackening in employment among coal-miners. On the other hand, there was a falling off of employment in the iron and steel trades and some branches of engineering, and the depression in the cotton industry became more acute.

Unemployment in May 1938 was highest in Northern Ireland (28·5 per cent.) and Wales (26·9 per cent.) and lowest in the South-Eastern Division (7·2 per cent.), South-Western (7·6 per cent.), and London (7·7 per cent.). In the Midlands it was 10·2 per cent., and North-Eastern 13·7 per cent. In Scotland, the Northern and North-Western districts the rates were 16·3, 17·3 and 18·5 per cent. respectively.

Compared with twelve months earlier, employment was worse in all the important industries except marine engineering and shipbuilding, and public works contracting, but in the last-named industry the improvement was of the slightest and the rate of unemployment therein was 36·3 per cent. In the tinplate trade the rate of unemployment in May was as high as 48·7 per cent. and over two-fifths of the mills were not working. In trades covering over two and a half million workpeople the rate of unemployment ranged from 15 to 20 per cent.; in trades covering more than 1,200,000 it ranged from 20 to 30 per cent., and it ranged from 36 to 48 per cent. in trades covering about 400,000.

In *agriculture* employment fluctuated somewhat, but the rate of unemployment had fallen by the middle of May to 6·6 per cent. compared with 8·4 in February. The rate for males fell from 6·7 to 5·8 per cent. and that for females from 37·2 to 20·5 per cent., but out of the total of 690,000 included in the agricultural scheme only 38,900 are females.

The number of workpeople aged 14 to 64 (insured and uninsured) on the registers of the employment offices of the Ministry of Labour in Great Britain are given below for the latest four months.

Date	Wholly Unemployed	Temporarily Stopped	Persons normally in Casual Employment	Total
Feb. 14th, 1938 ...	1,404,912	335,084	70,425	1,810,421
Mch. 14th, „ ...	1,350,121	331,247	67,613	1,748,981
Apl. 4th, „ ...	1,321,061	358,278	68,425	1,747,764
May 16th, „ ...	1,314,118	397,529	67,158	1,778,805
May 24th, 1937 * ...	*1,140,118*	*189,529*	*67,158*	*1,396,805*
„ *25th, 1936* ...	*1,397,755*	*225,285*	*82,002*	*1,705,042*

* Revised figures.

Population: England and Wales. According to the latest figures published by the Registrar-General, the total population of England and Wales is estimated to have amounted to 41,031,000 persons as at the middle of the year 1937. The figure is some 1,079 thousand in excess of the number enumerated at the last Census in 1931, and indicates an average rate of growth over the six post-censal years of 0·43 per cent. per annum, following an average for the ten preceding intercensal years of 0·55 per cent. per annum. Of the total increase of 1,079 thousand, 704 thousand are to be accounted for by the excess of births over deaths, leaving 375 thousand to be ascribed to the miscellaneous movements summed up in the term migration; the latter has been inward on balance since about 1930, after having been almost consistently outward in character over a period of several decades.

Natural increase—*i.e.* the excess of births over deaths—accounted for an increase of population of 101 thousand in the year 1937. Owing to a somewhat heavy incidence of deaths due to influenza in the early part of the year, the figure is rather lower than it might otherwise have been, but compared generally with the numbers recorded since the last Census—viz., 130, 84, 121, 121 and 110 thousands in the years 1932–36 respectively—the level is sufficiently high and persistent to suggest that the population may be expected to continue to increase, though at a diminishing rate, for a decade or more, a period which may even be extended if the present inward migration tendency continues to supplement the natural increase.

Marriages: England and Wales. The marriages provisionally announced for 1937 number 357,886 or a rate, in terms of persons married, of 17·4 per 1,000 population. The rate maintains the high rate of last year (17·4), and, excluding the somewhat violent fluctuations associated with the period of the War, is higher than any recorded since 1873.

After the exceptional fluctuations associated with the War period and immediately succeeding years, the rate up to 1932 appears to have stabilized itself at a more or less constant level of between 15 and 16 per thousand, corresponding broadly with the pre-war position of the present century. Since 1933, however, it has steadily risen, and even when allowance is made for the differing age incidence in the population, it is necessary to go back to the period 1871/1880 to find a parallel to the present frequencies.

Births: England and Wales. Live births registered during 1937 numbered 610,850, corresponding to a rate of 14·9 per thousand population. The number is more than five thousand in excess of those of last year, while the rate is 0·1 per thousand higher.

The rates for the last four years have all been in excess of the minimum of 14·4 per thousand which was recorded in 1933. While the rise is not a large one, it is worthy of note that the present is the first occasion since the onset of the general decline which set in about 1876, when the rate has been more or less stable for a period as long as five years. Whether the period is merely an unusually extended halt, to be followed by a further decline, or whether it is to prove a more significant turning-point in the history of the rate, cannot be foreseen; it is of interest to note, however, that the partial records received so far this year suggest that the improvement is being accelerated rather than retarded.

The rate of reproduction represented by the present birth rate is, of course, wholly insufficient to maintain a stationary population in the indefinite future. Though the fertility records of this country are not yet available in the degree of detail necessary for their accurate expression in terms of a standard "net reproduction rate" as currently understood by modern investigators in this field of study, it may be stated that, from such approximate measurements as are possible, the crude birth rate corresponding to a full 100 per cent. net reproduction rate in this country at the present time would be in the neighbourhood of 19½ per thousand, so that the rate of 14·9 per thousand actually registered in respect of the year 1937 may be said to be about 24 per cent. below the full par value.

Deaths: England and Wales. The deaths registered in 1937 numbered 509,560, corresponding to a crude death rate of 12·4 per thousand population. The number is 13,796 greater than that of last year—the excess being largely due to the high influenza mortality of the first quarter of the year—while the rate is higher by 0·3 per thousand population. The current rate of 12·4 may be compared with 11·4, the minimum recorded for this country in 1930, and with 12·0, the average for the past five years.

The infant mortality rate was 58 per thousand live births, which is only 1 above the minimum reported in 1935; it may be compared with 59 last year and with 61, the average of the past five years.

The latest available age rates are those for the year 1936, recently published in Part I of the Registrar-General's *Statistical Review* for that year, and are as follows, comparative figures being added for the quinquennium 1931–35:—

Annual Deaths per 1,000 *Population in each Age-group*

Age (last birthday)	1936		1931–35	
	Males	Females	Males	Females
0–4	19·1	14·9	20·1	16·0
5–9	2·1	1·8	2·3	2·1
10–14	1·3	1·1	1·4	1·4
15–19	2·0	1·9	2·4	2·2
20–24	2·9	2·6	3·2	2·8
25–34	3·0	2·7	3·3	3·1
35–44	4·9	3·9	5·4	4·3
45–54	10·8	7·6	11·2	7·9
55–64	24·1	16·4	23·5	16·9
65–74	56·6	42·7	56·8	43·0
75–84	137·3	108·1	135·2	109·7
85 and over	291·4	259·5	278·8	247·6
All ages standardized *	10·4	8·2	10·7	8·6

* On basis of 1901 population of England and Wales.

(2) OTHER STATISTICS

Stock Exchange Securities. Over the three months' period February 18th to May 19th, 1938, there was an appreciable fall in the value of Stock Exchange Securities, both of Fixed Interest Stocks and of Variable Interest Securities. As measured by the index number of the *Bankers' Magazine* (prices at December 1921 = 100) the former declined 2·4 per cent. and the latter 4·8 per cent. Following the more or less general decline in March, there had been some noticeable general improvement in April, but during the last month of the period the decline reasserted itself in both categories of securities. British railway stocks fell away noticeably, and the decline in United States and other foreign railway shares continued, and the prices of nearly all industrial and commercial securities were lower, no doubt principally due to the absence of any marked signs of improvement in the industrial situation. The general index number for all classes of securities, which stood at 120·7 in February, fell to 115·9 in March, rose to 119·2 in April and fell back to 117·0 at May 19th. At May 19th, 1937, the index number was 127·8, or nearly 8·5 per cent. higher.

There was a slight improvement in *shipping freights* during May 1938 following on a continuous general fall from September 1937. The revised index number of the Chamber of Shipping * (1935 = 100), which had reached 201·7 in September 1937, had fallen to 141·0 by December 1937 and to 129·5 by February 1938. For March and April 1938 the index numbers were 127·5 and 126·9 respectively, thus showing as between September 1937 and April 1938 a fall of rather more than 37 per cent. For May the index number advanced to 130·6, owing principally to an improvement in outward freights (coal), but there was some slight advance in rates in the North American and West Indian markets. Compared with May 1937 freights show a fall of nearly 33 per cent.

Over the three months February to April 1938 there was a net increase of 3·4 per cent. in *retail sales* as compared with the corresponding period in 1937. According to the Statistics of Retail Sales prepared by the Bank of England in conjunction with various retail distributors' associations and co-operative societies, sales had shown an increase of 4·4 per cent. in February, a decrease of 3·7 per cent. in March and an increase of 11·4 per cent. in April, as compared with the same months in the previous year. Monthly comparisons were affected, however, by the incidence of the Easter holidays, which are eliminated over the three-monthly period. Sales of food showed an increase of 6·5 per cent.; articles other than food showed a slight decline (0·5 per cent.). The value of the sales of food was affected, no doubt, to some extent by the rise in food prices as compared with the same period in 1937, when retail prices were lower—about 3·0 per cent., according to the Ministry of Labour's index number of retail prices of articles of food purchased by the working classes.

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* See *Journal of the Royal Statistical Society,* Part I, 1938.

CURRENT NOTES

The Statistical Year Book of the League of Nations, bringing together as it does the most important statistics of different countries and in one volume and, so far as possible, in comparable form, has long since established itself as an indispensable work of reference for those dealing with problems of finance, production and consumption, trade, unemployment, wages and population. The 1937–38 volume, lately issued, contains some valuable material of kinds not previously included. The new tables in the population section showing age-composition, fertility, net rate of reproduction, and expectation of life will be especially appreciated in view of the current interest in population trends. Additions to the economic pages include figures of stocks of commodities and of alcohol and sulphuric acid. The explanatory notes in French and English which accompany all tables enable the reader to guard himself against the dangers which, Professor Bowley has pointed out, await those who use official statistics without being told exactly what they mean and what they do not mean.

The second issue of the *Recueil International de Statistiques Economiques* (published by the International Statistical Institute at the Hague) has just reached us, in the English edition (*International Abstract of Economic Statistics*). The statistical information is given in the form of index-numbers, both monthly and annual, and now includes between 40 and 50 series, compiled from the publications of the appropriate office or institution in each of the countries concerned :—*e.g.* for France and Italy the Statistical Institutes of the Universities of Paris and of Rome, for Germany the Institut für Konjunkturforschung, for Great Britain the London and Cambridge Economic Service, for the United States the Review of Economic Statistics, for Holland, Hungary and Canada the Central Statistical Offices. The indices cover finance, prices, trade, production, transport, loans, wages, employment, etc. Each country is treated in a separate section and the tables are preceded and illuminated by a brief summary of the economic events in each of the years surveyed. The first issue gave monthly and annual indices for the period 1919–30 for 16 of the principal countries, the second gives monthly indices for the years 1931–36 and yearly indices for the whole period 1919–36, and covers 31 countries. Their compilation in a single volume will save economic investigators an immense amount of labour, and the editor, Dr. J. B. D. Derksen, of the Central

Statistical Bureau of the Netherlands deserves much gratitude for the way in which he has carried out an arduous task.

The Cowles Commission is a not-for-profit corporation founded six years ago to investigate economic and statistical problems, and affiliated with the Econometric Society. For three years now an annual Research Conference on Economics and Statistics has been held under its auspices which is open to anyone interested in the two subjects. During the Conference, which lasts about a month, papers on various subjects are presented by prominent statisticians and economists from all over the world. The Report of the Third Conference, held in June–July 1937, contains summaries of thirty-nine papers. The majority of the subjects discussed are econometric, and the rest give a purely verbal account of the factors to be taken into consideration in dealing with various economic problems. The largest more or less homogeneous group among the papers deals with statistical theory, and accounts for nine papers; with this group may be mentioned a further four papers on probability. Problems concerned with prices and supply and demand analysis occupy seven papers, three of which are on Stock Market prices. Four deal with agricultural problems. Eleven or so deal with the econometric treatment of general economic theory (a very diverse collection), and the remaining four deal with miscellaneous subjects.

As slightly less than half of the papers are mathematical in form, the report as a whole requires from the reader a certain familiarity in reading mathematical symbols, and a degree of knowledge of modern mathematical statistics. Many of the papers are extremely condensed, and are not particularly easy reading. All those who are interested in the growth of statistical and econometric technique and the problems to which it may be applied should find helpful suggestions in this series.

Mr. Udny Yule has presented to the library a curious pamphlet printed at Richmond (Yorks) in 1859 entitled "Evidences of the Great Age of Henry Jenkins, with notices respecting longevity and long-lived persons." The British public takes so much interest in sporting championships that it may be surmised that a motive of the publication was to deprive the Shropshire man Thomas Parr of the longevity record and secure it for the Yorkist Henry Jenkins. A Yorkshire F.R.S. wrote (in the *Philosophical Transactions*) with a certain modest pride :—"Henry Jenkins was 12 years old when Flodden Field was fought, so that he lived 169 years. Old Parr lived 152 years and 9 months, so that Henry Jenkins outlived him by computation 16 years, and was the oldest man born on the ruins of this post-diluvian world." This was written more than two hundred years before the county of broad acres had established an, arithmetically speaking, more securely founded claim to at least one championship, viz. that of cricket; indeed the evidence does not amount to much more than proof that Henry Jenkins's contemporaries at any rate believed him to be a very old man. A legal deposition of 15th April, 1667, shows a commendable restraint. It begins :—"Henry Jenkins, of Ellerton-upon-Swale, labourer, aged 157, or thereabouts, swore, etc., etc." It will be remembered that the other claimant of championship honours, Thomas Parr, came under the notice of the great William Harvey. Harvey, who made a *post mortem* examination of his body, was satisfied that Parr was a very old man, but did not critically examine the evidence in favour of the alleged age at death. Harvey does, however, make a curious observation. He says that Parr's memory was greatly impaired, and that he recollected scarcely anything of what had happened to him when he was a young man. But, it seems, he could recollect "the events of the last few years." This is sufficiently odd, because many of us who are mere boys in comparison with old Parr have precisely the opposite experience—viz., ease in recalling distant and difficulty in remembering recent events. Perhaps it goes to prove what, statistically speaking, hardly needed proof: that those who live to 150 are very exceptional people.

Fellows will have already noticed with much satisfaction that in the Birthday Honours His Majesty was pleased to raise Sir J. C. Stamp to the peerage. Baron Stamp of Shortlands, to give him his new title, has been a Fellow since 1911, and has served the Society on the Council, as Honorary Secretary, and as President; of his numerous and valuable papers read before the Society there is no need to speak here. Lord Stamp has received this honour for his public services and amongst these to be reckoned in a high place are his services to statistics. The Council are proud that the first statistical peer should come from their ranks.

Fellows will also be gratified to learn that the Institute of Actuaries have presented a gold medal to Sir William Palin Elderton, their late President, in recognition of his services to actuarial science. Sir William has been a Fellow of this Society for nineteen years, and has often served on the Council, where his colleagues have repeatedly had occasion to profit by his valuable co-operation. He has never read a Paper before the Society, but the Council still hope that this omission will one day be rectified.

The International Federation of Documentation and the Association of Special Libraries and Information are to hold their Annual Conferences (the fourteenth and fifteenth respectively) at Lady Margaret Hall, Oxford, during the fourth week in September. Sir William Bragg will preside over the meetings of the International Federation, and Sir William Beveridge over those of "Aslib." Many foreign governments are sending delegates, and societies and institutions at home and abroad will be represented at both conferences. Among the subjects to be discussed by the Federation are: The making of abstracts for periodical literature; Applications of indexing systems; Theories of cataloguing in indexing systems. The second section (Wednesday, September 21st) includes a paper on the indexing of statistical literature "Umstellung einer statistischen Fachbibliothek auf der Dezimalklassifikationssystem," by Dr. W. Scheifer of the Statistical Office of Vienna, and on the Thursday, Dr. L. M. Kern, Librarian of the Federal Library, Bern, will read a paper on "Schweizerische Bibliographie für Statistik und Volkswirtschaft." The Aslib programme will open with an address by the President on "The Use of Books in Social Science," and among other papers are "Problems of International Documentation," by Dr. J. Alingh Prins, and "Evaluation of Scientific and Technical Periodicals," by Mr. E. Lancaster Jones, Keeper of the Science Library, London, where, it should be mentioned, the last meeting of the Federation will be held. It will be devoted to the photographic reproduction of documents, and will include an exhibition of apparatus. The arrangements for the meetings include excursions and visits to places of interest in and around Oxford.

Full particulars and application forms can be obtained from :—

Miss M. Gosset,
Hon. Secretary, Organizing Committee,
Science Library,
South Kensington,
S.W.7.

The Agricultural Economics Society announces that the total prize money of £15 offered by the Society in its Essay Competition for 1937–38 has been divided equally between the following three competitors :—

(*a*) Mr. G. G. Firth, University College, London, for an essay on "Agricultural Tariffs and Quotas in Europe since 1924—their Growth and Objects."

(*b*) Mr. W. E. Richards, University of Reading, for an essay on "The Influence of a more Adequate and Well-balanced Dietary for all Classes upon the Character of British Agricultural Output."

(*c*) Mr. G. D. Salmon, University of Leeds, for an essay on "Social and Economic Changes in the Position of Farm Workers during the Last Twenty Years."

The Editors regret that on p. 316 of Part II, the names of the candidates elected to Fellowship in February (which appears again, correctly, on p. 375) were substituted for the list of those elected at the January meeting. The list should have read :

James Herbert Bingham, M.I.Mech.E.
William Frederick Fenn Kemsley.
Thomas Williams Nevard.
Dick Haydon Tobilcock.
Edmund Hannay Watts.

Corporate Representative

Alan Russell Smith *representing* Imperial Chemical Industries, Ltd.

OBITUARY

Albert Delatour, 1858–1938

Of the Honorary Fellows of our Society, two only date their election to pre-war years, and the death on March 5th, in his eightieth year, of Monsieur Delatour, removes from the list one of those next following these in seniority, having been elected in the last year of the War. It was as a leading figure in the French group of Members of the International Institute of Statistics that he became known to us, and in that capacity he took a prominent part in the conferences at which, shortly after the end of the War, the resumption of the activities of the Institute was discussed and the plan of procedure was worked out. He had become a member of the Institute in 1891 and at the last pre-war meeting, held at Vienna in 1913, he became one of its Vice-Presidents. The joint Committee to which was entrusted the work of preparation for the first post-war meeting, made up partly of leading members of the Institute, partly of persons nominated by the League of Nations, carried out its work under M. Delatour's chairmanship. Though not a professional statistician, he understood the character and aims of statistical work very thoroughly, and guided with great skill, tact and devotion the work of that Committee, which was not terminated with the resumption in 1923 of regular meetings of the Institute. He was, at the 1923 meeting, elected President of the Institute, his predecessor, Professor Luigi Bodio, having died in 1920. His disposition, and long experience in important posts in the public service, qualified him admirably to represent the Institute as its titular chief at the six meetings held in the period of his presidency, which terminated in 1931 with the Madrid meeting. This is not the place to recite the marks of distinction received by M. Delatour in his own country and elsewhere. His devoted service to the cause of statistics, particularly as represented by the work of the International Institute, was marked by his election as Honorary President of that body when he retired from the active work of its President. Those of us who were brought into contact with him will not forget his unfailing courtesy and the apt choice of phrase with which he expressed the appreciation of the welcome accorded, in the various capitals, to the Institute whose spokesman he was on so many occasions.

Paul I. Georgievsky, 1857–1938

Professor Paul Georgievsky, who died at Prague on March 25th at the age of eighty-one, was the foremost economic statistician of

Tsarist Russia. In 1914, the year of his election to Honorary Fellowship of this Society, he held the highest statistical position attainable in his country—that of President of the Statistical Council of the Russian Empire.

He was appointed to the Chair of Political Economy at the University of Petersburg in 1890 and made Emeritus Professor in 1908. In 1883 he took over the financial statistics of the Russian Railways, which he entirely reorganized. In 1911 he was appointed Director of the Central Statistical Council and greatly extended the activities of that body. He was made a Privy Councillor in 1912 and in the same year was entrusted by the Government with the arrangement of the Second All-Russia Census and with the reorganization of the statistics of the Ministry of the Interior. In 1916 the Emperor made him a Senator.

During the early part of the Russian revolution he held the post of Professor of Political Economy at the Tavrichesky University at Simferopol. After the revolution he left Russia, and was for some time in Constantinople. In 1922 he was appointed Professor of Statistics to the Russian Faculty of the University of Prague. The completion of his fifty years of scientific and social work, from the publication of his first book in 1879, was celebrated in Prague in 1929, and a Note offering him the Society's congratulations appeared in the *Journal*, Part I, of that year.

Professor Georgievsky did not seek money or honours. He was devoted to his scientific work at the University, and was greatly loved by all his students, whom he was always ready to help or advise. In his early years he devoted much of his time to the question of public social assistance and private charity; a number of his written works deal with this subject, and it was through his activities that the Bureau for the Registration of the Poor and the first Russian " Shelter Colony " was founded at St. Petersburg.

Even in advanced age Professor Georgievsky never relinquished his scientific work. He was always a prolific writer, and during recent years he contributed a number of articles on Statistics in the USSR to the *Statistical Journal of the Czechoslovak Republic.* In 1934 he wrote, among other works, *The Present Day Crisis and the Means to Fight It*, and in 1935 a larger work, *The Depopulation of France* (1825–1935). These have not yet been published.

GEORGE JAMES SHORT BROOMHALL, 1857–1938

Mr. George Broomhall, who died on the 23rd of June, in his eighty-second year, had been a Fellow of the Society since 1895. He was the leading commercial statistician of the grain trade in this country, and was the founder and editor of *Broomhall's Corn Trade News*, a daily journal which specialized in the collection and compilation of statistics of shipments of grain throughout the world. These, though unofficial, became the most widely employed statistics for measuring the volume of the world's trade in wheat and flour, and Mr. Broomhall's editorial reviews of the position and prospects of the world's wheat supplies were recognized as representing an authoritative and unprejudiced opinion. He was, indeed, one of the first to undertake the task of estimating annually the supplies of wheat likely to be available for world consumption, a type of statistical work which has since been developed on parallel lines by the International Institute of Agriculture in Rome, the United States Department of Agriculture, and in the Wheat Studies published by the Food Research Institute of Stanford University, California.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

UNITED KINGDOM—

Agricultural Economics Society, Journal, June, 1938—The practice of price stabilisation: *A. N. Duckham*. Some aspects of price fixing policies: *W. H. Jones*.

Annals of Eugenics, May, 1938—The genetic interpretation of studies on cancer in twins: *P. A. Gorer*. The distribution of entries in a contingency table with fixed marginal totals: *W. L. Stevens*. The estimation of the frequencies of recessive conditions in man: *J. B. S. Haldane*. A psychometric sociological study of a group of speciality salesmen: *Noel Wallace* and *R. M. W. Travers*.

The Banker—

June, 1938—The B.I.S. report: *H. V. Hodson*. Germany and Europe: *W. G. J. Knop*.

July, 1938—A retrospect of French finance: a correspondent.

Bankers' Magazine, May, 1938—The national finance. Cost of living, investments and profits: *E. T. Good*. India and the excess gold problem: *D. B. Ramchandra Rau*.

Biometrika, June, 1938—On some properties of normal distributions, univariate and bivariate, based on sums of squares of frequencies: *G. Udny Yule*. A historical note on Karl Pearson's deduction of the moments of the binomial: *J. Neyman*. Growth-rate determinations in nutrition studies with the bacon pig, and their analysis: *John Wishart*. Rural mortality; its comparative sex incidence: *W. J. Martin* and *E. A. Cheeseman*. A new method of experimental sampling illustrated on certain non-normal populations: *G. B. Hey*. A new measure of rank correlation: *M. G. Kendall*. The probability integral transformation for testing goodness of fit and combining independent tests of significance: *E. S. Pearson*. Some aspects of the problem of randomization, II, an illustration of "Student's" inquiry into the effect of "balancing" in agricultural experiments: *E. S. Pearson*.

Economic Journal, June, 1938—Methods of research—a plea for co-operation in the social sciences: *E. F. M. Durbin*. Economists and their critics: *Professor L. M. Fraser*. The concept of hoarding: *Joan Robinson*.

Economica, May 1938—The value of international trade: *J. B. Condliffe*. The analysis of vital statistics: I, marriage statistics: *R. R. Kuczynski*. Statistical evidence on the acceleration principle: *J. Tinbergen*.

Eugenics Review, April, 1938—Some anthropological characteristics of hybrid populations: *J. C. Trevor*. A declining birth-rate and the cost of education: *Grace G. Leybourne*.

UNITED KINGDOM—*Contd.*

Geographical Journal—

April, 1938—A local example of the factors influencing industrial location: *E. Charlesworth.*

May, 1938—The Tees-side iron and steel industry: *J. T. Gleave.*

Institute of Actuaries, Journal, Part I, 1938—Some reflections on long-term investments with particular reference to the business of life-assurance: *E. H. Lever.*

Institute of Bankers, Journal—

May, 1938—Farming advances: *F. L. Bland.*

June, 1938—The evolution of the money market: *Norman Crump.*

Lloyds Bank Monthly Review—

June, 1938—The economic outlook in Central Europe: *Gerhard Schacher.*

July, 1938—The budget: *O. R. Hobson.*

Public Administration—

April, 1938—The family and the social services: *P. Ford.* The control of the central authority over the activities of public undertakings: *Arthur L. Dakyns.* The public servant in Germany: *Dr. Erich Kordt.*

July, 1938—Social trends in rural areas; administrative problems, (a) General survey: *L. Elmhirst*, (b) Education: *Henry Morris*, (c) Transport and allied subjects: *Edward Stead.*

Review of Economic Studies, June 1938—François Simiand's theory of economic progress: *R. Marjolin.* Some regional aspects of the building boom, 1924–1936: *Marian Bowley.* Expectations and the scope of economics: *P. M. Sweezy.*

Sociological Review, April, 1938—Childless marriages: *R. R. Kuczynski.* Notes on some population data from a Southern Nigerian village: *Enid Charles* and *C. Daryll Forde.* Social origins of a sample of entrants to Glasgow University: *Adam Collier.*

INDIA—

Indian Journal of Economics, April 1938—[Whole number.] Papers read and discussed at the twenty-first conference of the Indian Economic Association held at Hyderabad, January 1938, including: Recent trends in trade cycle theory: *M. K. Muniswamy.* Trade cycle and its remedies: *R. Mukherjee.* Indian unemployment and its remedy: *S. P. Saksena.*

Sankhyā, Indian Journal of Statistics, May 1938—The case for the restriction of the output of coal in India: *J. R. Guha Thakurta.* A note on the correlation between results in the college and university examinations: *D. P. Acharya* and *P. C. Mahalanobis.* On a Bessel Function population: *S. S. Bose.* On the distribution of the means of samples drawn from a Bessel Function population: *R. C. Bose.* Limits to the accuracy of estimated moment coefficients: *K. A. Norton.* Statistical investigations on crop-weather relationship in India: *L. A. Ramdas* and *R. J. Kalamkar.*

UNITED STATES—

American Academy of Political and Social Science, Annals, May, 1938—Social problems and policies in Sweden. Commemorating the tercentenary anniversary of the first settlement of Swedes in America. . . . [Whole number.]

American Economic Review, June, 1938—The relation of surpluses to income and employment during depression: *Don D. Humphrey.* The liquidity-preference theory of interest: *Max Millikan.* The Bank for International Settlements in recent years: *E. L. Dulles.*

American Statistical Association, Journal, June 1938—The function of deposit banking: *E. A. Goldenweiser.* New indexes of production and trade: *N. O. Johnson.* Pitfalls in the field of statistical forecasting: *L. E. Truesdell.* The reliability of preliminary price indexes: *W. B. Garver.* Variations in family living expenditures: *D. S. Brady.* Discrete frequency distributions: *H. Muench.* Comparability of mortality statistics: *T. A. Janssen.*

Annals of Mathematical Statistics, March, 1938—Combined expansions of products of symmetric power sums and of sums of symmetric power products with application to sampling: *Paul S. Dwyer.* On the independence of certain estimates of variance: *Allen T. Craig.* Variance of a general matching problem: *J. A. Greenwood.* The large-sample distribution of the likelihood ratio for testing composite hypothesis: *S. S. Wilks.*

Harvard Business Review, Vol. XVI, No. 3—What can we do about depressions? *Elmer C. Bratt.* Science, statistics, and business: *T. H. Brown.* The recovery of world foreign trade: *Hugh B. Killough.* The new economic policy of the Dutch East Indies: *J. A. de Haas.*

Journal of Political Economy—

April, 1938—The anomalous course of South African gold mining since 1925: *Philip S. Brown.* Railway nationalization and transport co-ordination in France: *H. E. Dougall.*

June, 1938—The maintenance of agricultural production during depression: the explanations reviewed: *J. K. Galbraith* and *J. D. Black.* The progress of mass production and the German small-scale industries: *Walter Egle.* Speculation and the risk-preference: *Harold Barger.*

Milbank Memorial Fund Quarterly, April, 1938—The frequency of surgical procedures in a general population group: *Selwyn D. Collins.* Sex differences in mortality in the United States: *D. G. Wiehl.* Birth order and the decline in the birth rate: *C. V. Kiser.*

Quarterly Journal of Economics—

May, 1938—Germany's defence economy and the decay of capitalism: *F. Wunderlich.* Some fundamentals in the theory of velocity: *Howard S. Ellis.*

——*Supplement*—Rudimentary mathematics for economists and statisticians: *W. L. Crum.*

UNITED STATES—*Contd.*

Review of Economic Statistics, *May*, 1938—Price flexibility: *E. S. Mason.* The "multiplier" in practice: some results of recent German experience: *C. Bresciani-Turroni.*

Social Research, *May*, 1938—Germany's population miracle: *Hans Staudinger.*

Wheat Studies of the Food Research Institute—

April, 1938—Monetary influences in postwar wheat prices: *V. P. Timoshenko.*

May, 1938—World wheat survey and outlook May 1938: *H. C. Farnsworth* and *H. Working.*

DENMARK—

Nationaløkonomisk Tidsskrift, *Hefte* 2, 1938—Arbejdsløshedsproblemet før og nu: *Even Marstrand.* Struktur, Konjunktur och Sparkvot: *Johan Akerman.*

FRANCE—

Journal des Économistes, *Mars-Avril*, 1938—Les événements d'une période trouble. Ce que peut être l'avenir prochain: *Edouard Payen.* Le jeu des réformes sociales. La situation de l'industrie houillère française en 1937: *E. R.* Le commerce et l'industrie aux États-Unis en 1937: *Frank D. Pavey.*

Journal de la Société de Statistique de Paris, *Juin*, 1938—Le tabac et les allumettes (suite et fin). Relation entre les recettes des tabacs et les budgets des états: *Léon Blondeaux.*

Revue d'Économie Politique, *Mars-Avril*, 1938—Quelques observations sur la méthode de Léon Walras: *Bertrand Nogaro.* Politique des salaires et équilibre économique: des mirages du pouvoir d'achat aux impératifs de l'imputation: *René Courtin.* La notion économique de service public: *François Trevoux.* Le problème de la dénatalité: *Jacques Delevsky.*

GERMANY—

Allgemeines Statistisches Archiv, *Heft* 4, 1938—Das Problem des internationalen Steuerbelastungsvergleichs: *Joachim Lemcke.* Zur Methode der Statistik von Wirtschaftsrechnungen: *Alfred Jacobs.* Die Säuglingssterblichkeit der Mehrlingsgeborenen: *Franco Savorgnan.* Zu den Vorschlägen Reicherts über die Bestimmung des inneren Wertes der Geburtenziffer: *F. Hage.*

Archiv für mathematische Wirtschafts- und Sozialforschung, *Heft* 2, 1938—Über die Erfolgsaussichten von Massnahmen gegen Erbkrankheiten (1): *Otfrid Mittmann.* Die Vermehrungsrate der stabilen Bevolkerung: *Arthur Linder.*

GERMANY—*Contd.*

Blätter für Versicherungs-Mathematik und verwandte Gebiete, Juni, 1938—Neuere sterblichkeitsstatistische Untersuchungen und ihre Bedeutung für die Lebensversicherungspraxis: *Felix Burkhardt.* Die einjährige Sterbenswahrscheinlichkeit als Hilfsgrösse zur Bestimmung des technischen Durchschnittsalters von Personengruppen in der Lebensversicherung: *Heinrich Jecklin.* Bewegung des Frauenüberschusses in der reichsdeutschen Bevölkerung: *Erika Lieb.*

Weltwirtschaftliches Archiv, Mai, 1938—Die Einkommenschwankungen in der dänischen Landwirtschaft und ihr Einfluss auf andere Erwerbszweige in den Jahren 1922–1935: *Jørgen Pedersen.* Der Gewinn der Produktionsmittelbesitzer als Rechtfertigung des Schutzzolles: *Konstantin Bobtschev.*

Zeitschrift für die gesamte Versicherungs-Wissenschaft, Juni, 1938—Die Sozialversicherung in Süd- und Nordamerika: *Otto Paul.* Inwieweit steht die Krankenversicherungsmedizin hinter der Lebensversicherungsmedizin zurück? *Hans Göbbels.*

ITALY—

Le Assicurazioni Sociali, Gennaio-Febbraio, N. 1, 1938—La nuova reforma delle assicurazioni per le pensioni in Germania: *Franz Seldte.* Edilizia rinnovatrice in Inghilterra: *Kingsley Wood.* Il programma di sicurezza sociale negli Stati Uniti: *Arthur J. Altmeyer.* (A Supplement contains the first of these articles in German, and the other two in English.)

Economica—

Aprile, 1938—La funzione marittimo-continentale dell'asse e la cooperazione economica Italo-Germanica: *Mario Alberti.*

Maggio, 1938—Il sistema della rimunerazione corporativa integrale: *Carlo Emilio Ferri.* I consumi medi di combustibile sulle ferrovie italiane dello Stato: *Bruno Tenti.*

Giornale degli Economisti—

Maggio, 1938—Risparmio e consumo: *Amedeo Gambino.* Statistica metodologica e calcolo delle probabilità: *Francesco Brambilla.*

Giugno, 1938—Il valore nella dottrina moderna: *J. G. Kretschmann.* A proposito di un preteso errore nella dottrina dello scambio internazionale: *Alberto Breglia.*

JAPAN—

Kyoto University Economic Review, December, 1937—Unemployment and wages: a critical review of Mr. Keynes' theory of unemployment: *Professor Y. Takata.* The expansion and consolidation of the Japanese gold exchange standard system: *Professor K. Matsuoka.*

SWEDEN—

Ekonomisk Tidskrift, Häft 2, 1938—Spridda studier rörande de nationalekonomiska sammanhangen: *David Davidson.*

INTERNATIONAL—

Metron, N. 2, 1938—Di una formula comprensiva delle medie: *C. Gini.* Contributi alla teoria delle medie: *R. Cisbani.* Methods for the combination of observations: modal point or most lesser-deviations, median loci or least deviations, mean loci or least squares, and mid-point of least range or least greatest-deviation: *C. Bruen.* The analysis of variance and covariance in non-orthogonal data: *S. S. Wilks.* On the analysis of variation in general death rates: *A. Ollivier.*

International Labour Review—

April, 1938—International aspects of the terminology and ideology of management: *Hugo von Haan.*

May, 1938—Unemployment compensation in the United States: *E. M. Burns.*

International Review of Agriculture, April, 1938—Colonial agricultural credit.

Revue de l'Institut International de Statistique, Livr. 1, 1938—Einige alte und neue Masze des natürlichen Bevölkerungswachstums: *W. Winkler.* Quelques observations sur la question des classifications statistiques: *E. Szturm de Sztrem.* Der Geburtenrückgang. seine Ursachen und seine wirtschaftlichen und sozialen Wirkungen (I–II): *W. Winkler.*

LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part II, 1938, the Society has received the publications enumerated below:

I.—OFFICIAL PUBLICATIONS

(a) **United Kingdom**

Agriculture and Fisheries, Ministry of. Economic series No. 46. Hops: report of Reorganisation Commission for England. London: H.M.S.O., 1938. 9¾″ × 6″. 38 pp. 1*s.*

Air Ministry. Report of the Committee of Inquiry into Civil Aviation and the observations of H.M. Government thereon. London: H.M.S.O., 1938. 9¾″ × 6″. 87 pp. 1*s.* 6*d.*. Cmd. 5685.

Coal Industry Commission. Vol. I. Reports and minutes of evidence on the first stage of the inquiry. 414 pp. 3*s.* 6*d.* Vol. II. Reports and minutes of evidence on the second stage of the inquiry. Pp. 415–1219. 7*s.* Vol. III. Appendices, charts, and indexes. 318 pp. 6*s.* London: H.M.S.O., 1919. 13″ × 8¼″. (From Mr. J. Menken.)

Forestry Commission. Utilization series No. 4. Report on the demand for timber in ship-building and in the docks and harbours. London: H.M.S.O., 1938. 9¾″ × 6″. 55 pp. + ix plates. 1*s.* 3*d.*

Health, Ministry of—
- Departmental Committee on the cost of hospitals and other public buildings. Final report. 121 pp. 2*s.*
- Reports on public health and medical subjects No. 83. Report on anti-venereal measures in certain Scandinavian countries and Holland. 156 pp. 2*s.* 6*d.* [London: H.M.S.O., 1938. 9¾″ × 6″.]

Imperial Economic Committee—
- Grain crops: a summary of figures of production and trade relating to wheat, wheat flour, barley, oats, maize, rye, rice. 9¾″ × 7¼″. 84 pp.
- World consumption of wool 1937: a supplement to Wool Intelligence Notes. . . . 13″ × 8¼″. 132 pp. [London: H.M.S.O., 1938. 2*s.* 6*d.*]

Industrial Health Research Board. Report No. 83. The assessment of psychological qualities by verbal methods: a survey of attitude tests, rating scales and personality questionnaires. By *P. E. Vernon.* London: H.M.S.O., 1938, 9¾″ × 6″. 132 pp. 2*s.*

Labour, Ministry of—
- Committee on Holidays with Pay. Report. 9¾″ × 6″. 79 pp. 1*s.* 3*d.* Cmd. 5724. Appendix to minutes of evidence. 13″ × 8¼″. Pp. 410–447. 6*s.*
- Unemployment Insurance Statutory Committee . . . on the financial condition of the Unemployment Fund on 31 December 1937, Reports. 9¾″ × 6″. 66 pp. 1*s.* [London: H.M.S.O., 1938.]

Medical Research Council. Special report series—
- 227. Epidemics in schools: an analysis of the data collected during the first years of a statistical inquiry, by the Schools Epidemics Committee. 289 pp. 4*s.* 6*d.*
- 228. A study of epidemic influenza: with special reference to the 1936–37 epidemic, by *C. H. Stuart-Harris*, *C. H. Andrewes* and *W. Smith* with *D. K. M. Chalmers. E. G. H. Cowen* and *D. L. Hughes.* 151 pp. 2*s.* 6*d.*
- 229. A clinical and genetic study of 1280 cases of mental defect. By *L. S. Penrose.* 159 pp. 2*s.* 6*d.* [London: H.M.S.O., 1938. 9¾″ × 6″.]

(a) **United Kingdom**—*Contd.*

Overseas Trade, Department of—

Reports: 695. Australia, November 1937. 161 pp. 2*s.* 6*d.* 696. Latvia, January, 1938. 55 pp. 1*s.* 697. Hungary, 1935–37. 46 pp. 1*s.* 698. Iran, 1937. 41 pp. 1*s.* 699. Iraq, 1935–1937. 47 pp. 1*s.* 700. Netherlands, March, 1938. 86 pp. 1*s.* 6*d.* 701. Honduras, March, 1938. 26 pp. 9*d.*
[London: H.M.S.O., 1938. 9¾″ × 6″. 7 parts.]

Royal Commission on the Coal Industry (1925), Report. Vol. 2, Parts A and B. Minutes of evidence. 1056 pp. 25*s.* Vol. 3. Appendices and index. 455 pp. 15*s.* London: H.M.S.O., 1926. 13″ × 8¼″. 3 vols. (From Mr. J. Menken.)

Transport, Ministry of—

Highway development survey 1937. (Greater London.) *Sir Charles Bressey*, C.B., Engineer, *Sir Edwin Lutyens*, K.C.I.E., R.A., Consultant. 13″ × 8¼″. 68 pp. + 2 maps. 7*s.* 6*d.*

Report on road accidents in Great Britain involving personal injury (fatal and non-fatal), year ended 31st March, 1937. 9¾″ × 6″. 75 pp. 1*s.* 3*d.*
[London: H.M.S.O., 1938.]

(b) **Dominions, Colonies, and Protectorates**

Canada—

Dominion Bureau of Statistics—

Seventh census, 1931. Vol. V. Earnings of wage-earners, dwellings, households, families, blind and deaf-mutes. Ottawa, 1935. 9¾″ × 6¼″. xlvii + 1730 pp. $1.

Census monograph No. 4. Racial origins and nativity of the Canadian people. A study based on the census of 1931 and supplementary data. Ottawa, 1937. 9¾″ × 6½″. xvii + 292 pp. 35*c.*

Éire—

Industry and Commerce, Department of. Ireland: Census of population, 1936. Vol. I. Population, area and valuation of each district electoral division and of each larger unit of area. Dublin: Stationery Office. 1938. 10″ × 6½″. vii + 143 pp. 2*s.*

(c) **Foreign Countries**

Austria—

Bundesamt für Statistik. Statistik des Bundesstaates Österreich Heft 12. Die natürliche Bevölkerungsbewegung in Österreich in den Jahren 1933 bis 1936. Vienna, 1937. 12½″ × 10″. 29 pp.

Österreichisches Statistisches Landesamt. Statistisches Jahrbuch, 1938. Vienna, 1938. 10″ × 6½″. xii + 293 + 8 pp.

Czechoslovakia—

Office de Statistique—

Prager geophysikalische Studien VIII. Die Temperaturverhältnisse der Hauptstadt Prag. Teil 1. 1937. 111 pp.

Recensement de la population . . . . 1930. IIe. Tome. Profession de la population. 3e. partie. Profession et répartition sociale de la population (étrangers y compris) par nationalité ethnique et par religion. 1935. xv + 36 + 256 pp.

Statistik der unmittelbar gezahlten Einkommensteuer, der Besoldungssteuer von höheren Bezügen, der unmittelbar gezahlten Rentensteuer, der allgemeinen und besonderen Erwerbsteuer für das Jahr 1932. 1937. xxviii + 235 pp.

Statistik der Zivilgerichtsbarkeit für die Jahre 1932–1933, 1937. xx + 82 pp.
[Prague, 12¼″ × 9¼″.]

(c) **Foreign Countries**—*Contd.*

Egypt—

Finance, Ministry of. Statistical Department. Egypt trade statistics. 1936 : a new classification for international use. Cairo, 1938. 11¾″ × 8″. 32 pp.

Germany—

Statistisches Reichsamt—

Statistik des deutschen Reichs, Bände: 510. Die Verbreitung von Tierseuchen und die Ergebnisse der Schlachtvieh-und Fleischbeschau im Jahre 1935. . . . 124 pp.

—511. Umsatzsteuerstatistik 1935. Teil I. 207 pp.

—512. Die öffentliche Fürsorge im Deutschen Reich in den Rechnungsjahren 1932 bis 1936. Heft 1. 61 pp.

[Berlin, 1938. 12″ × 8½″.]

Italy—

Istituto Centrale di Statistica. Atlante dei comuni del Regno d'Italia. Rome, 1938. 12½″ × 9½″. 94 maps. Indice alfabetico dei comuni del Regno.

Palestine—

Office of Statistics. Statistical abstract, 1936. Jerusalem, (London : Crown Agents for the Colonies), 1937. 9¾″ × 6¼″. 103 pp. 4*s.* (From Mr. H. T. Curwen.)

Poland—

Office Central de Statistique—

Deuxième recensement général de la population du 9 décembre 1931. Logements et ménages, population, professions. Fasc. 65, 77, 78, 83.

Statistique de la Pologne Serie C. Fasc. 81. Statistique des transports par les voies navigables intérieures 1931–1936. 34 pp.

—Fasc. 84. Tables et indications pour l'application statistique de la methode des échantillons tirés au sort. Fasc. 1. La statistique de l'alternative simple. Les tirages individuels, sans divisions, par *Aleksander Rajchman.* 43 pp.

[Warsaw, 1938. 11¼″ × 8″.]

Sweden—

K. Socialstyrelsen—

Levnadsvillkor och hushållsvandor i städer och industriorter omkring år 1933. 327 pp.

Skogsbygdens arbets-och levnadsvillkor. Del. 1. Utredningens huvudresultat. xii + 361 pp.

Undersökningar rörande arbetstidsförhållanden och lönevillkor för privatanställda. 325 pp.

[Stockholm, 1938. 9½″ × 6½″. (From Uppsala University.)]

United States—

Agriculture, Department of—

Miscellaneous publications: 265. A graphic summary of farm labor and population. 48 pp. 10 *c.* 274. Soil survey manual. 136 pp. 35 *c.* 282. Sales of cotton for future delivery 1925–26 to 1935–36. 42 pp. 10 *c.* 283. Economic survey of the live-poultry industry in New York City. 115 pp. 15 *c.* 297. Farm family living outlook for 1938. 11 pp. 5 *c.*

Technical bulletins: 587. Consumption and production of tobacco in Europe. 115 pp. 15 *c.* 588. The sterilization of wool and its effect on physical and chemical properties of a wool fabric. 26 pp. 5 *c.* 591. Relation of stable environment to milk production. 60 pp. 15 *c.* 602 Relation of spot cotton prices to prices of futures contracts and protection afforded by trading in futures. 100 pp. 15 *c.*

[Washington, 1938. 9″ × 6″.]

(c) **Foreign Countries**—*Contd.*

Census, Bureau of the—

Census of American business. Retail distribution, 1933. By areas, stores and sales by business groups for states, counties and cities. 198 pp. Chains and independents and other types of operation. 102 pp. Stores and sales by size of city. 10 pp.

—Wholesale distribution, 1933. United States summary of wholesale trade. Kind of business in detail 1933 and 1929. 22 pp.

[Washington, 1936. 10½″ × 8″. (From Mr. Menken.)]

Fifteenth census of the United States, 1930. Construction industry. Summary for the United States. 1933. 180 pp.

—Construction industry. Construction in the United States : a study of its location and agencies. 1933. 33 pp.

—Distribution of sales of manufacturing plants. 1932. 95 pp.

—Retail distribution. Summary for the United States. 1933. 179 pp.

—Retail distribution. How to use commodity sales data in state reports and the significance of such data. 1932. 13 pp.

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JOURNAL

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PART IV, 1938.

THE EFFECTS OF OCCUPATION AND OF ITS ACCOMPANYING ENVIRONMENT ON MORTALITY

By PERCY STOCKS, M.A., M.D.

[Read before the ROYAL STATISTICAL SOCIETY, May 17th, 1938, the PRESIDENT, LORD KENNET OF THE DENE, P.C., G.B.E., D.S.O., D.S.C., in the Chair.]

TEN years ago Dr. T. H. C. Stevenson read a paper to this Society on " The Vital Statistics of Wealth and Poverty," in which he dealt with the social classification based upon occupation as distinct from industry which had been introduced into the occupational mortality enquiry of 1921–23. I recollect that occasion well, because in the discussion I had the hardihood to make some comments and suggestions for the next enquiry, little thinking that I should later find myself in the similar position of having to justify fundamental changes which had been made and to explain why other changes had not been made. When at the beginning of the session a promise was given to present another paper on occupational mortality, it was in the full belief that the Report for 1930–32 would have been published before now; but unfortunately, owing to recent pressure of work upon our enthusiastic but numerically inadequate staff, the Report is still in the printer's hands, and consequently I have had to modify the form of this paper considerably. For this I ask your indulgence, for it must to some extent hamper the discussion. The particular aspect of occupational mortality I propose to deal with is the attempt to separate the direct effects of a man's daily work from the accompanying indirect effects of the environment in which, generally by compulsion rather than by choice, he lives in order to carry out that work.

Occupational and Industrial Mortality in Different Parts of England and Wales, 1851–1923

Dr. Stevenson, in the paper referred to above, made the following pertinent observation :—

" The problem, however, of taking differences of occupation into account simultaneously with those of geographical situation and urbanization is not easy of solution. Even the largest occupation groups in the census classification, such as coal-miners, clerks, or agricultural labourers, are of such a size that if divided simultaneously by situation (in any degree of detail) and by urbanization, the numbers available for comparison, after the indispensable further subdivision by age, would frequently be insufficient to yield significant results. The tabulator of statistics is indeed constantly faced by the difficulty that his returns will not bear the degree of subdivision theoretically desirable."

This difficulty explains, perhaps, why the early tabulations of occupational deaths in detail of area which were carried out by the Registrar-General for 1851, 1860–61, and 1871 were not continued. The 14th Annual Report tabulated in 75 pages the census populations and deaths of males over 20 years of age for the year 1851 in over 300 occupations in each geographical division, county and town district, but notwithstanding all this material, the Report made no comment upon local characteristics of occupational mortality. The Supplement to the 25th Annual Report contained a more detailed tabulation at 12 separate ages of the deaths of males in a great variety of occupations and industries during 1860–61 in 11 geographical divisions and the aggregates of town districts in those divisions, but the whole of this tabulation of 115 pages was dismissed by Dr. Farr in four characteristic sentences, as follows:—

"As in the case of towns, so it may be said of men of unhealthy occupations; the mortality is susceptible of reduction by the investigation and removal of its causes. Thus the miner may be protected from explosions; and to a large extent from underground injuries by greater care on his own part and on the part of the managers and proprietors. He may be saved from the excessive fatigue of ladder climbing; and if the mines were well ventilated, he would not break down by so early and premature an old age. The publican has only to abstain from excesses in spirits and other strong drinks to live as long as other people."

No mention was made of local distribution but Dr. Farr, in his evidence to a Royal Commission on the Condition of Mines in 1864, made comparisons between the mortality of metal-miners in Cornwall during 1849–53, and those of non-miners in Cornwall and of coal-miners in Durham and Northumberland. In the Supplement to the 35th Annual Report, the tabulation of deaths in 1871 of males by occupation, age and geographical region was repeated in rather less detail, but although Dr. Farr then extended his comments to six pages the only use he then made of the elaborate regional analysis of occupational deaths was to compare the mortalities of butchers and of publicans in London with those in the rest of England. This comparison, translated for convenience into percentage indices, is shown in Table I.

TABLE I

Relative Mortality of London Butchers and Publicans, 1860–61, 1871

	London Death-rates per cent. of those in the Rest of England and Wales at Ages :—						
	15–	25–	35–	45–	55–	65–	75 and over
All males, 1861–70 ...	97	112	134	142	139	128	113
Butchers, 1860–61, 1871...	128	105	123	128	126	111	124
Publicans, 1860–61, 1871	68	117	117	135	130	146	155

Although no general deductions were drawn from these, it is the first demonstration I have found in official records that men following the same occupation suffer a higher mortality in the town than in the country. It is rather surprising that with all the material available in these three Reports for 1851, 1860–61 and 1871, defective in many aspects though it was, no attempt was made to answer the question whether the higher total mortality of towns in the middle of last century could be explained by the effects of certain industries upon the workers engaged in them and upon their families, or whether it was a characteristic of all residents of towns regardless of their occupations. Dr. Farr did not, as far as I know, make any reference either to the question whether the high mortality associated with an occupation could be explained by its location chiefly in places rendered unhealthy by other factors. In no report subsequent to 1871 has a combined tabulation of deaths by occupation or industry and by region or class of area been repeated, except for miners, a peculiar people, from whom it is scarcely safe to make general deductions.

In the Supplement to the 45th Annual Report (1881, page xxviii), however, Dr. Ogle pointed out that there were some industries "from which the element of locality is inseparable, as they are only carried on in more or less circumscribed areas," quoting as instances the cotton industry, the manufacture of hosiery and of cutlery and files. "It is conceivable," he said, "that if the cotton manufacture were carried on in some other totally different part of England, the mortality from all and several causes in that industry might be different from what it is at present; but as things stand, whatever influence on mortality may belong to the geographical position of Lancashire attaches inseparably to the cotton industry," and he suggested that the mortality in this industry might be usefully compared with that of all males in Lancashire rather than with all males in England and Wales. In Table VI of that report, and again in the three succeeding Decennial Supplements, the deaths of coal-miners in different counties were distinguished, but no comparison with the mortality of other persons resident in those counties was made.

The absence of any study of regional occupational mortality since the detailed tabulations of 1851, 1860–61 and 1871 followed naturally, perhaps, from the little use which was made of them. An additional reason can be found in the need which arose after 1881 to introduce another important variable into occupational mortality —namely, cause of death, on which attention has been rightly focused to an increasing extent. The neglect has been unfortunate, however, in that it has resulted in a good deal of fallacious reasoning. On the one hand certain localities such as Lancashire have earned the reputation of having an unhealthy climate, whereas they suffer chiefly from having extended their hospitality, in the days before town planning or control of housing was known, to certain industries which brought in their train unhealthy conditions of life, not only for those engaged in them, but also for others who had to live in the towns which they produced. The rural districts of Lancashire now show no important excess of mortality over the average rural area.* On the other hand, certain occupations have given the statistical impression of being intrinsically unhealthy, whereas their unfavourable mortality arises mainly from their peculiar localization in certain counties whereby the workers and their families share higher death-rates, consequent upon racial selection, local habits of life or the unhealthy conditions produced by other industries which predominate there. An example of this, probably attributable to the first two factors, is the significantly high cancer rate found in 1930–32 amongst workers in slate, for whom the registered and calculated deaths in the three years at ages 20–65 were as follows:—

	Registered Deaths	Standard Deaths	Excess
Slate-miners, masons, etc. ...	51	36	+15
Caernarvonshire only ...	34	21	+13
Remainder	17	15	+ 2

The excess was found to be almost entirely located in Caernarvonshire, which county is characterized by high cancer death-rates in the population of both sexes. Any occupation which, though well distributed through the country, is only carried on in the large towns may present higher mortality rates on that account, although the fault does not lie with that occupation but with the conditions created by other urban industries. The agricultural labourer is for the same reason fortunate not only in the nature of his occupation, but also in his residence in those parts of the country whose housing and atmosphere have not been affected in a harmful way by other industries.

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* In 1936 the adjusted death-rate of Lancashire rural districts was 92 per cent. of the national rate, compared with 91 per cent. for all rural districts outside Greater London; for the Lancashire county boroughs, however, the ratio was 129 compared with 112 for all county boroughs outside Greater London.

The coal-mining industry generally produced its own local conditions of town-building and housing, harmful alike to the miners, to their families and to the non-miners whose work compelled them to live in the mining towns and villages. Attention has been called to the regional variations of mortality of the miners themselves at intervals since 1880–82, and in Table II the mortalities of miners in the principal coalfields have been expressed as percentages of those of miners in all the coalfields combined. This has also been done for the entire populations resident in the urban and rural districts of the same counties in 1911 and 1931, and in the whole counties in 1931.

The South Wales coal-miner recorded at the close of the last century a mortality about 15 per cent. above the average for all coal-miners, and the Lancashire miner also recorded a similar excess, whilst the Nottingham and Derby miner, on the other hand, returned a mortality about 20 per cent. below average. In 1910–12 the Lancashire miner showed the highest figure (129) whilst the Nottingham and Derby miners ranked lowest (80), and this contrast was much greater than appeared in the general mortality of those counties in 1911. By 1930–32 the range of coalfield variation was much reduced to 93–110, and the differences were scarcely greater than were apparent between the general death-rates of the populations. It is shown at the foot of the table that the coal-miners' mortality variation could not contribute anything appreciable to the variation in the general mortality of the counties, so the county indices may be regarded without appreciable error as those of non-miners. It then appears that the 17 per cent. excess of mortality for Lancashire miners over that of the Nottingham and Derby miners in 1930–32 was matched by a 19 per cent. excess for other persons resident in the same counties; so the difference is unlikely to be occupational in origin. For the South Wales miners, however, their 10 per cent. excess over the average was matched by only about 3 per cent. excess for other persons living in Glamorgan or Monmouth urban or rural districts. The Durham and Northumberland

TABLE II

Relative Mortality of Coal-miners in Different Coalfields, 1880–1932

		Notts and Derbyshire	Durham and Northumberland	Staffordshire	Yorkshire West Riding	Lancashire	South Wales
		Mortality of coal-miners expressed as percentage of the corresponding rate for coal-miners in all the coalfields.					
Coal-miners (below or above ground).	*Ages.*						
1880–82 ...	25–45	86	102	102	86	104	118
	45–65	81	96	106	87	105	123
1890–92 ...	25–65	79	84	103	98	116	121
1900–02 ...	25–65	80	90	100	93	119	112
1910–12 ...	25–65	80	87	99	101	129	107
Coal-miners working below ground.							
1921–23 ...	20–65*	85	94	96 ‡	101	113 §	111
1930–32 ...	20–65*	93	93	99 ‡	98	109 §	110
		Standardized general mortality in urban or rural aggregates or entire counties expressed as percentage of the corresponding rate for the whole group of coal-mining counties.					
Whole population of both sexes							
1911 U.D.'s	All ages	89	102	98	102	103	99 †
R.D.'s	„	92	115	86	102	93	99 †
1931 U.D.'s	„	92	101	96	99	102	101 †
R.D.'s	„	93	108	92	104	91	103 †
County	„	89	103	95	97	106	99 †
		Population of men in coal-mining occupations expressed as percentage of the whole population of both sexes.					
1931 County	—	7·4	8·5	3·8	5·1	1·6	11·2 †
		Excess or defect in the general mortality indices above which could be attributed to the coal-miners' variation.					
1931 County	—	Less than 1					+1

* Standardized rates.
† Glamorgan and Monmouth only.
‡ Includes some miners in Shropshire and Worcestershire.
§ Includes some miners in Cheshire.

group of miners has consistently shown a low mortality, notwithstanding the high general death-rate in Durham county.

Before the deaths for 1930–32 were available I had occasion to make a comparison between the death-rates from bronchitis, pneumonia and respiratory tuberculosis amongst coal-hewers and other residents in the counties of Nottingham, Derby, Glamorgan and Monmouth during 1921–23,* and the results of this comparison at ages between 25 and 65 are summarized in Table III.

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* *Journal of Industrial Hygiene,* XVII, No. 5, 1935, p. 217.

TABLE III

Relative Mortality of Coal-hewers from Respiratory Disease, 1921–23

	Mean Annual Death-rate per 100,000 Living, 1921–23				Per cent. Excess of Mortality in Glamorgan and Monmouthshire	
	Nottingham and Derbyshire		Glamorgan and Monmouthshire			
	25–45	45–65	25–45	45–65	25–45	45–65
Bronchitis and pneumonia.						
Hewers and getters	39	222	51	305	+30	+37
Non-miners (males)	60	209	75	282	+24	+35
Females	35	118	36	155	+ 4	+31
Respiratory tuberculosis.						
Hewers and getters	72	88	84	117	+16	+34
Non-miners (males)	126	127	168	153	+34	+21
Females	102	60	137	76	+34	+26

The excess in mortality from respiratory diseases and phthisis amongst coal-hewers and getters of South Wales in comparison with those of Nottingham and Derby, which was believed to arise from differences in the mines or the material mined, was thus found to be present also in the mortality of male non-miners and of females of the same ages resident in the same counties. These examples illustrate how faulty conclusions may be drawn from occupational statistics alone unless consideration is given to local variations in general mortality.

In the Supplement to the Registrar-General's 55th Report comparison was made between the mortalities of farmers and graziers in a group of agricultural counties * and those of all farmers and graziers, but the analysis was not made in such a way as to show to what extent farmers were affected by the proximity of other industries in comparison with the rest of the population. It might be expected that of all classes in the community farmers would be least affected in their mortality by the presence or absence of manufacturing industries in a county, and it is of interest to ascertain what was the position in this respect in 1890–92. From the tabulated deaths and populations the rates for farmers and for non-farmers have been calculated at various ages in the agricultural group of counties on the one hand and in the remaining counties of England and Wales which were more industrialized, on the other, and these are shown in Table IV, together with the percentage excess of mortality in the remainder.

* Defined as counties in which one-third or more of the occupied males over 10 years of age were farmers or farmers' labourers.

TABLE IV

Mortality of Farmers, Other Males and Innkeepers or Servants, in Agricultural and Remaining Counties at Various Ages, 1890–92

	15–	25–	35–	45–	55–65
	Mean annual death-rates of males, per 100,000.				
*Agricultural Counties.**					
Farmers	207	409	639	1016	2069
Non-farmers	327	614	920	1423	2668
Innkeepers, hotel servants	278	1139	1988	2783	4639
Remaining Counties (including London).					
Farmers	172	442	742	1182	2588
Non-farmers	384	754	1310	2222	3973
Innkeepers, hotel servants	504	1547	2524	3666	5414
	Percentage excess or defect in mortality in remainder of country compared with agricultural counties.				
Farmers	−17	+ 8	+16	+16	+25
Non-farmers	+17	+23	+42	+56	+49
Innkeepers, hotel servants	+81	+36	+27	+32	+17

At ages 15–25 the farmers registered a lower rate in the industrial counties, but at ages between 25 and 65 an excess was present, though very much less than for the rest of the population. Another occupation group whose mortality was separately tabulated in 1890–92 in the agricultural counties was that of innkeeper and hotel servant, and a similar comparison has been made for them in Table IV. They recorded a greater excess at ages under 35 in the remaining areas than did all non-farmers, but at ages 35–65 they showed a slighter degree of excess.

In the Supplement to the Registrar-General's 65th Report separation of the mortality of coal-miners in the various coalfields and of farmers, innkeepers and hotel servants in the agricultural and industrial counties was again made for 1900–2, but if it is desired to study the regional variation of, or effect of urbanization or industrial conditions upon, the mortality of men engaged in any other occupation, it is necessary to go back to the detailed tabulations of deaths and populations for 1851, 1860–61 and 1871 and work out the necessary rates. Taking carpenters and joiners as an example—an occupation well defined in its description, and one which must have been at that time well distributed throughout the population, both urban and rural—I have given in Table V a comparison between mortality during 1860–61 in London, in the industrialized counties of Lancashire and Cheshire and in the rural counties of the east and south-east, comprising Norfolk, Suffolk, Essex, Surrey, Kent, Sussex, Hampshire and Berkshire.

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* See footnote on p. 675.

TABLE V

Mortality of Carpenters and All Males in Industrial and Rural Areas at Certain Ages, 1860-61

	25–	35–	45–55
	Death-rates in 1860–61 per 100,000 census population.		
London { All males	946	1519	2287
London { Carpenters	628±65	949±90	1837±153
Lancashire and Cheshire { All males ...	1017	1495	2260
Lancashire and Cheshire { Carpenters ...	765±82	1161±115	2058±180
East and South-East Counties { All males ...	917	1115	1481
East and South-East Counties { Carpenters ...	823±80	874±95	1409±132
	Percentage excess over mortality in East and South-east.		
London { All males	+ 3	+36	+54
London { Carpenters	—24	+ 9	+30
Lancashire and Cheshire { All males ...	+11	+34	+53
Lancashire and Cheshire { Carpenters ...	— 7	+33	+46

Note.—The standard errors shown in the table are ratios of the square root of the number of deaths to twice the census population.

At ages 25–35 carpenters in the rural south-east suffered a higher mortality than in London. At 35–55 Lancashire and Cheshire carpenters suffered the same degree of mortality excess as did all males in those counties, but London carpenters presented a slighter degree of urban excess than was shown by London males as a whole.

Similar studies of these data might be extended to other occupations, perhaps with some profit, but my purpose here has been to call attention to these tabulations as a source of information of which not much use was made and which have never been repeated. One interest of such analyses is that, provided they were based upon deaths corrected by transfer to the place of residence and that fairly good agreement existed between the description of occupation on the census schedule and death-certificate (conditions only imperfectly fulfilled in these early data), it would be theoretically possible to discover to what extent the higher mortality in towns or in certain parts of the country is due to the less healthy occupations of their inhabitants, including the home conditions which those occupations necessitate, and to what extent the higher mortality of certain occupations is due to their concentration in places rendered less healthy by factors not connected with the occupation. We might thus avoid a vicious circle of faulty reasoning in which it is easy to become ensnared. In the remainder of this paper I shall give an account of some methods by which it has been sought by less laborious means to separate to some extent the effects of industry, social class, occupation, urbanization, density of housing and climate upon mortality.

Mortality in Towns Classified According to the Industries in which the Population was Engaged, 1911–34

In an attempt to ascertain to what extent the mortality in towns increases with the presence of certain industries, I have in Table VI divided up the 83 county boroughs into groups according to their industrial character, and obtained for each group in each period 1911–14 and 1931–34 the average excess of their standardized mortality ratios over those of the rural parts of the counties in which the towns are situated. It was in 1911 that the transfer of deaths to place of residence began to be applied in England and Wales as a whole, and from that date also deaths were tabulated by administrative areas rendering comparison between urban and rural mortality much more reliable. Standardized death-rates expressed as percentages of the corresponding rates for England and Wales were given for 1911–14 and 1931–34 in the Registrar-General's Review for 1934 (Table XCVII) for each county borough and these have been further corrected by the time-comparability factor method which was introduced in the Review for 1935. In Table VI the towns outside Greater London have been divided into the seaside resorts, the Tyneside and Durham towns, South Wales towns, other ports and coastal towns, and the remaining inland towns of England have then been grouped according to the industrial employment of their populations in 1931. Unweighted average standardized mortality ratios are given for each group in columns (1) and (2), the corresponding figure for England and Wales as a whole being 100 in each instance. In the next column is shown the average of the differences between the standardized mortality in 1911–14 of each county borough and that of the aggregate of rural districts of the county in which it is situated, expressed as a percentage of the average S.M.R. of the rural aggregates. The averages used were unweighted, each town being treated as a unit. Column (4) gives the corresponding percentage excess in 1931–34. In column (5) is shown the percentage decline in the standardized death-rate in 1931–34 compared with 20 years previously. The last column gives the unweighted averages of the indices of housing density for each group at the census of 1931, and shows a continuous increase in the average number of persons housed per room

TABLE VI

Comparison of Mortality of London and of the County Boroughs Grouped According to Industry, with that of the Rural District Aggregates of the Counties in which they are Situated

	Average Standardized Mortality Ratio (S.M.R.)		Percentage Excess over average S.M.R. of Rural Parts of same Counties		Per cent. Fall in Standardized Death-rate	Persons per Room 1931
	1911–14	1931–34	1911–14	1931–34		
	(1)	(2)	(3)	(4)	(5)	(6)
England and Wales	100	100	—	—	—	0·83
London A.C.	107	104	49	30	30	0·98
Towns of London's Outer Ring	93	99	27	25	24	0·94
Tyneside and Durham coast towns	126	123	24	16	30	1·14
South Wales towns	113	116	24	14	26	0·88
Seaside Resorts	86	94	13	12	22	0·70
Ports and Coastal towns not included above	115	112	12	27	30	0·86
Inland Towns (except Greater London) of England.						
1. With 50% or more of all males over 14 at work in mining or manufacturing industries ...	121	113	39	23	33	0·96
2. With 25 but less than 50% of all males over 14 at work in mining or manufacturing industries:						
(*a*) Including 10% or more in textile industry ...	124	122	35	27	29	0·87
(*b*) Including 30% or more in mining, pottery, metal, chemical, leather or textile industries	116	109	27	14	32	0·87
(*c*) Including 15 but less than 30% in mining, pottery, metal, chemical, leather or textile industries ...	110	109	31	21	29	0·79
(*d*) Including less than 15% in mining, pottery, metal, chemical, leather or textile industries ...	99	98	22	13	29	0·78
3. With less than 25% of all males at work in mining and manufacturing industries	94	95	21	12	28	0·75

with increasing proportion of males employed in mining and manufacture.

In 1911–14 London's mortality was 7 per cent. above, and the average mortality of the neighbouring rural areas was 28 per cent. below the national rate, London's excess above the neighbouring rural areas being 49 per cent. In 1931–34 this excess was reduced to 30 per cent. In the Tyneside and Durham and South Wales towns the excess was 24 per cent. in 1911–14 and 14–16 per cent. in 1931–34, for the seaside resorts it amounted to 12 or 13 per cent. in each period, but for other coastal towns the excess was 42 per cent. in 1911–14 and 30 per cent. in 1931–34. The high rates for the ports arise partly from the fact that the number of seafaring men dying in hospital or at their homes is out of proper proportion to the number employed on shore at the census, since the onset of illness often causes them to remain ashore.

The inland towns of England having half or more of their male population actually at work in the manufacturing or mining industries, excluding building, at the census of 1931 had an average mortality 39 per cent. above the neighbouring rural areas in 1911–14 and 23 per cent. above in 1931–34. In the next group, having a quarter to half of their male population employed in manufacture or mining, the textile towns still have a mortality 27 per cent. above the rural areas, whilst for the other subgroups the excess ranges from 13 to 21 per cent. For the towns with less than a quarter of their males employed in manufacture or mining the excess over the neighbouring rural areas is now no greater than in the seaside resorts. From this it appears that the harmful effect of the smoke-producing heavy or textile industries upon health has diminished somewhat during the last 20 years, for the excess of mortality in the towns most engaged in these industries over that in the rural areas has fallen from 35–40 per cent. to about 25 per cent. The excess in these towns is still considerably greater than is shown by towns with small proportions employed in the heavier manufactures, where it ranges from 12 to 21 per cent. The towns which grew up around the coal, steel, textile and shipbuilding industries during the early part of the nineteenth century are still those with the least satisfactory mortalities, owing, it may be surmised, to the great difficulties which have stood and still stand in the way of correcting the mistakes then made.

Relation between Mortality in the Towns and Rural Areas and the Distribution of Social Classes, 1929–34

The Registrar-General's Review for 1934 contained a study of the association between four factors relating to the 83 county boroughs in the period 1929–33, using the correlation method. The indices correlated were :—

M = standardized mortality ratio for the whole population of both sexes.
L = latitude zone in which the town is situated.
H = housing density index, or mean number of persons per room in 1931.
S = social class index, or proportion of males over 14 years of age whose occupation placed them in social classes IV (partly skilled) and V (unskilled workers).

The index H ranged from 0·64 in Bournemouth to 1·23 in Gateshead, and the social class index from 196 per 1,000 in Southend to 520 in Grimsby.

The following correlation coefficients with their standard errors were obtained :—

	Crude Coefficient	Coefficient when other Two Factors are Constant
Mortality with latitude	0·651±0·079	0·375±0·095
Mortality with housing index	0·771±0·044	0·510±0·082
Mortality with social index	0·685±0·058	0·290±0·101

When each town was weighted in proportion to its population, the crude coefficients were slightly modified to 0·72, 0·70 and 0·67 respectively. After applying the method of partial correlation, there remained an independent correlation of each index with mortality, which appeared to be significant, that with social class distribution, as roughly measured by the index S, being about 0·3. When the mortality in each county borough was expressed as a percentage of that calculated by a regression formula based upon the three variables and the above correlation coefficients, it was found that the figures ranged from 85 for Tynemouth to 121 for Oldham, whereas the original standardized mortality (M) ranged from 83 for Eastbourne to 138 for Oldham, the variance having been reduced from 194 to 52 by the process of correcting for the three factors. It seems reasonable to conclude from this that if the housing density of persons per room in the northern towns could be reduced to the same level as in the southern towns, leaving the population unchanged, their mortality would fall considerably; if the population was then redistributed as regards its occupations to the same proportions as in the southern towns, a further fall would occur, but there would still remain an excess due to other factors, of which probably the most important are diminished sunlight owing to more cloud and smoke, and the damper and slightly colder climate.

In the same report the standardized mortality in each administrative county—that is to say, excluding the large towns—in 1931 34 was compared with the housing density and social class indices, H and S. The proportion of males over 14 in Classes IV and V ranged from 242 per 1,000 in Middlesex to 508 in the Holland Division of Lincolnshire, and it was found that the nine counties with the highest values of this index gave an average mortality figure of 90 and that the nine counties with the lowest social class index also gave an average of 90, compared with the general average for all the administrative counties of 95. Class IV includes the agricultural labourer—a very healthy occupation—and it was evident that no such correlation between the social class distribution and mortality existed in the administrative counties as was found amongst residents in the large towns. The deduction was made that "the correlation between a social classification based on occupations and mortality is a phenomenon characteristic of town-dwellers and in mixed populations consisting of dwellers in rural districts and small towns it is not clearly seen." It is now possible to test that conclusion more directly.

The Decennial Supplement on Occupational Mortality for 1930–32 will contain a tabulation of the mortality of men in each social class resident in Greater London and in each regional aggregate of county boroughs, other urban districts and rural districts, and from this it is possible to examine in a direct manner the actual variation according to urbanization and region of the mortality experience of each social class separately, and thus eliminate, by a process more satisfactory than partial correlation of indices, the effects of the differing social class distributions in different parts of the country.

Extracts from the data for males are given in Table VII, where the English regional aggregates of county boroughs are arranged in order of the mortality of males aged 20–65 standardized both for age and social class distribution. When so arranged the southern and eastern aggregates come first, and the four northern aggregates last, with the Midlands intermediate. The mortalities of social classes II, III and V show much the same order of progression as for all males, the chief exception being the high rate for Class II in the West Riding. Class II mortality indices range from 94 to 125 in terms of that of males of that class in all areas (country as well as town) taken as 100; Class III indices have a similar range from 91 to 120, and Class V indices have a higher range from 83 to 133. For these three classes the excess of mortality in the northern compared with the southern towns is 20, 18 and 30, compared with 20 for all males. For Class I, the professional class, including officers of the Army, Navy and Air Force, no excess of mortality in the northern towns is apparent, for the average index in the four northern aggregates is 98 and for the four southern aggregates 99. For Class IV also, the partly skilled class, the northern towns do not show as great an excess of mortality as for Classes II, III and V.

A few of the Class I ratios for regions having only a small county borough population are based upon rather small numbers of deaths.

The lower part of the Table makes the same comparison for married women grouped according to their husbands' social class (as described in the next section), the regional aggregates of towns being arranged according to the male mortality figures as before.

TABLE VII

Standardized Mortality in 1930–32 *of Males and of Married Women of each Social Class at Ages* 20–65 *in Greater London and Regional Aggregates of County Boroughs per cent. of that in the same Social Class in England and Wales* (*all areas*)

	All Males	Males of the Social Class Specified				
		I	II	III	IV	V
East...	93	84	98	91	92	93
South-East †	96	104	98	93	128	83
Greater London	100	101	96	98	113	102
South-West	103	108	94	105	120	92
Midland II	104	105	107	103	108	97
Midland I	109	93	110	107	120	105
North III	113	91	119	112	113	113
North II	115	79	106	112	122	119
North I	120	116	120	116	119	126
North IV	125	107	124	120	129	133
Wales	119	131	125	116	117	120
Average of four southern and eastern regions ...	98	99	97	97	113	93
Average of four northern regions	118	98	117	115	121	123
Excess for northern towns	+20	−1	+20	+18	+8	+30

	All Married Women	Wives of Men of the Social Class Specified				
		I	II	III	IV	V
East...	99	91	105	93	112	101
South-East †	89	92	90	88	96	85
Greater London	90	101	90	88	93	90
South-West	102	95	114	103	93	99
Midland II	106	105	103	107	102	107
Midland I	102	106	108	105	101	96
North III	108	112	111	104	107	115
North II	115	104	102	110	119	127
North I	120	96	108	119	118	131
North IV	118	119	115	116	113	127
Wales	116	93	118	121	104	110
Average of four southern and eastern regions ...	95	95	100	93	99	94
Average of four northern regions	115	108	109	112	114	125
Excess for northern towns	+20	+13	+9	+19	+15	+31

* Corrected for age and social class.

† Excluding Greater London. The regions are as defined by the Registrar-General, North I consisting of Durham and Northumberland, North III West Riding and York, North IV Lancashire and Cheshire, North II the other northern counties. Midland I the west midland counties, etc. (see Table 17 of *Statistical Review* for complete definition).

The married women's indices corrected for age and social class distribution follow almost the same order as the men's, the only variations being the higher ratio in the East and a reversal of order of the Midland aggregates and of North I and IV. Class I shows in contrast to the men a northern excess similar to that of Class III, and the northern excess is again most pronounced for Class V. From this it may be concluded that the mortality of the unskilled class of men resident in county boroughs and of their wives is most sensitive to northern conditions, and that men of the professional classes are not affected by these as regards their total mortality between the ages of 20 and 65, although their wives show a northern excess similar to that in Classes II–IV. This lack of northern excess amongst Class I males arises chiefly from a higher accidental death rate amongst the southern residents, motor transport and aviation contributing largely to this in the period under review.

A similar analysis of male mortality between the ages of 20 and 65 in rural districts according to region is given in Table VIII.

TABLE VIII

Standardized Mortality in 1930–32 *of each Social Class at Ages* 20–65 *in Regional Aggregates of Rural Districts, per cent. of that in the same Social Class in England and Wales (all areas)*

	Males or Married Women	All	Social Class				
			I	II	III	IV	V
East	M	70	(91)	76	75	66	56
South-East	M	76	(100)	77	75	72	70
North II	M	79	(92)	82	78	77	72
Midland II	M	81	84	84	83	76	75
North IV	M	81	117	91	83	75	74
Midland I	M	84	79	89	90	75	81
South-West	M	84	(101)	85	89	74	83
North III	M	87	(89)	83	(99)	83	62
North I	M	92	(120)	(96)	90	(98)	68
Wales II	M	97	(108)	(97)	108	88	87
Wales I	M	103	123	(104)	113	(103)	70
Average of three southern and eastern regions ...	M	77	97	79	80	71	70
	M.W.	*88*	*97*	*93*	*81*	*89*	*86*
Average of four northern regions	M	85	105	88	88	83	69
	M.W.	*103*	*117*	*101*	*106*	*99*	*87*
Excess for northern counties	M	+8	+8	+9	+8	+12	−1
	M.W.	*+15*	*+20*	*+11*	*+25*	*+10*	*+1*

* Rates for all males (or married women) corrected for age and social class in the area specified. For definition of regions see note below Table VII.

The regional aggregates are arranged in order of the mortality figure for all males corrected for differences in age and social class distribution, and the range of this figure is from 70 to 103, compared with 93 to 125 for the county borough aggregates, but the progression from south to north is not so definite. Class I figures for separate regions are based upon numbers of deaths ranging from 238 down to 22, but for the other classes the number was in no instance less than 140. Indices in the upper part of the table which differ from 100 by less than 1½ times their standard errors are shown in brackets. The differences between the averages of the four northern and the three southern and eastern aggregates corrected for class and age are 8 for males and 15 for married women, compared with a northern excess of 20 in each case for the county boroughs. The chief contrast arises for the unskilled Class V, who show no northern rural excess for males and no appreciable excess for their wives, compared with excesses of 30 and 31 respectively in the county boroughs. Whereas the unskilled town labourer is more affected than any other class by northern conditions, the unskilled rural labourer is less affected than any other class.

Mortality of Men Compared with that of the Wives of Men in each Social Class and in Various Occupations, 1930–32

The attempt to separate the direct effects of a man's work upon his mortality from the effects of the industry in which he is working, operating through his general environment, began prior to the 1921 census, when the occupational classification was reconstructed so as to group together men engaged in the same kind of work rather than those employed in the same branch of an industry. The resulting mortality investigation in 1921–23 was consequently more correctly described as occupational than any which preceded it. The separate tabulation of the census population according to occupation and industry also made it theoretically possible to effect some separation of occupational from industrial influences, and for certain occupations, such as that of weaver, where it is known to be of importance, subdivision of the deaths according to industry has been made, but since the localization of industries then leads to the further need for a regional separation, this pathway towards truth loses itself in the wilderness as a rule, because the subdivisions have become numerically so small that their mortality rates are subject to a variation too large to render them conclusive. What is needed is some kind of control population which can be paired off with the men in a given occupation and subjected to the indirect influences attached to it, such as its urban or rural localization, without taking part in the occupation itself. Given such a control, the need for the threefold division into occupation, industry and locality would disappear, and the problem would be simplified. It is extremely fortunate that a control group which fulfils most of these requirements is provided for us in the mortality experience of the wives of the occupied men.

The Registrar-General's Occupational Mortality Report for 1921–23 contained this statement:—

"It will be found from the following pages that the effect of occupation upon male mortality is probably on the whole more indirect than direct—that mortality is influenced more by the conditions of life implied by various occupations than by the direct occupational risks entailed. The figures for males do not permit of differentiation between the two types of influence, as both are at work in every case, so no definite proof can be adduced of this suggestion, which merely represents an impression created by study of the facts dealt with. But from the deaths of females another set of data might be obtained which would serve to distinguish the two types of occupational influences being entirely dependent upon the indirect."

The report went on to suggest that the mortality of married women might be tabulated according to the husband's occupation in order to differentiate between the direct and indirect effects of occupation on male mortality:—

"For no trade could longer be regarded as directly prejudicial to health if it were found to entail as much excess risk for the wife as for the husband. In such a case excess mortality would evidently be in the main attributable to the social conditions implied."

In 1930–32 this suggestion was followed up by making a complete tabulation of married women's deaths according to the social class of the husband, and an experimental tabulation for the wives of men in selected occupations which had returned an unusually high or low male mortality in 1921–23 or were otherwise of special interest. Of the 8,603,598 married women enumerated at the 1931 census, 8,007,886 or 93 per cent. were on the same schedules as their husbands, and the occupation of the husband was therefore known. The remainder consisted of wives whose husbands were outside England and Wales, or who were living apart or happened to be in a different locality on the census date, and were consequently enumerated on a different schedule. In order to construct the complete population of married women for class or occupation, the number enumerated with their husbands, classified by age, was first raised to the total of married women in the class, and each age-group was then adjusted by a factor regarded as identical for all classes or occupations at that age, in order to produce the correct total of married women as ascertained at the census. The deaths of all married women in 1930–32, numbering 240,726, were then tabulated according to the husband's social class or occupation, and by cause, and related to the adjusted populations. The husband would usually be the informant at the registration of his wife's death, and the description of his occupation on the wife's death-certificate may be expected to agree more closely with the description of it on the census schedule than would be the case at the registration of his own death, so errors in mortality rates arising from such lack of agreement should be of slighter importance for married women than for males. One defect of the analysis in 1930–32 is that the mortality experience of all males engaged in an occupation, whether married or not, is being compared with that of the wives of the married men only as a control. This was inevitable, because we have as yet no record in the death register of the civil condition of males, but only of females. The mortality figures we wish to compare are, however, relative and not absolute indices, and it seems unlikely that the relative mortality of the married men in an occupation at a given age in terms of that of all married men differs to an important degree from the relative mortality of all men in that occupation in terms of that of all males at the same age. It is hoped that by the distinction in the death register of married males which will be possible from July 1st of this year, this difficulty will be removed in the 1941 occupational analysis, and that a more exact comparison may then be possible between married men's mortality and that of their wives. Another defect of the married women as a control group arises from the fact that some are themselves engaged in occupations outside their homes. About 10 per cent. were recorded as gainfully occupied in 1931, of whom about a third were employed in textiles and dressmaking and a third in domestic or personal service. The validity of the wives' mortality as a basis of comparison cannot be seriously affected by this factor except in the case of textile workers, innkeepers and men of a few other occupations, for whom it must be borne in mind.

With these reservations, the mortality experience of the wives of men engaged in an occupation or social group of occupations during 1930–32 provides much the best measure of the general mortality background, bereft of the direct occupational risks, of men in those groups, and in the remainder of this paper a few examples will be given of the results obtained by this method. The standard mortality ratio (S.M.R.) at ages 35–65 for a group is the percentage ratio of the number of registered deaths to the number calculated by applying the death-rates of all married women at three ages, 35–44, 45–54 and 55–65, to the populations at the same ages of wives of men in that group. The S.M.R. at 20–65 was obtained similarly by adding the age-group 20–35 to these registered and calculated deaths. For males the calculated deaths were obtained by applying the death-rates of all males to the census populations of males in the group at the component ages.

To what extent is the social class gradient of male mortality, which was noticed in 1910–12 and again in 1921–23, attributable to the kind of work done, and to what extent to the accompanying economic environmental and selective factors? It was shown in Table VII that married women's mortality is no more sensitive than that of males to regional differences when the effects of social class have been eliminated, and Table IX indicates that the effect of urban residence within the same broad geographical area is not so great upon the married women's mortality as upon that of males of the same social class.

TABLE IX

Comparison of Mortality of Males and Married Women of Three Social Groups Resident in County Boroughs and Rural Districts, 1930–32

	Standardized Mortality Ratios, ages 35–65					
	Classes I–II		Class III		Classes IV–V	
	Males	Married Women	Males	Married Women	Males	Married Women
Northern Regions.						
County boroughs	113	100	115	112	134	128
Rural districts ...	86	94	84	107	80	104
Urban excess ...	27	6	31	5	54	24
Southern and Eastern Regions.						
County boroughs	93	85	93	92	105	103
Rural districts ...	76	80	71	80	73	92
Urban excess ...	17	5	22	12	32	11

On the other hand, it is seen from Table X, which is compiled from material extracted from Table XXVIII of the Registrar-General's Review for 1932, that when the county boroughs and county aggregates of rural districts are grouped according to their housing densities as measured by the average persons per room, the range of women's mortality between the ages of 25 and 65 in 1930–32 was greater than that of men, the amount of increase with density being on the average about 1½ times that of the men.

These studies lead us to infer that married women's total mortality from all causes is more influenced by economic factors than that of men, although it is about equally affected by regional factors, and less affected by the mere fact of urban residence. This

Table X

Comparison of Mortality Variation of Males and Females at Ages 26–65 according to Density of Housing, in County Boroughs and Rural Districts, 1930–32

	Ages	Mortality per cent of that in England and Wales in Areas with the Specified Average Density of Persons per Room					
		0·55–	0·70–	0·85–	1·00–	1·15–1·30	Range
County boroughs.							
Males	25–45	101	102	117	121	145	44
Females	,,	93	97	113	116	139	46
Males	45–65	99	103	120	119	111	12
Females	,,	97	99	115	116	121	24
Rural districts (County aggregates).							
Males	25–45	82	86	90	—	106	24
Females	,,	90	95	113	—	126	36
Males	45–65	79	80	82	—	86	7
Females	,,	88	91	98	—	115	27

is borne out by the greater range of mortality from Class I to Class V for married women in England and Wales as a whole than for males as shown in Table XI.

Table XI

Comparison of Mortality Variation according to Social Class amongst Males in 1921–23 *and* 1930–32 *and Married Women in* 1930–32

Social Class	Standardized Mortality Ratios at Ages 20–65			Standardized Mortality Ratios at Ages 35–65	
	1921–23	1930–32		1930–32	
	Males (Civilians only)	Males (including Non-civilians)	Married Women by Class of Husband	Males (including Non-civilians)	Married Women by Class of Husband
I. Professional, etc. ...	82	90	81	90	82
II. Intermediate	93	94	89	95	90
III. Skilled ...	94	97	99	97	100
IV. Intermediate	99	102	103	102	103
V. Unskilled ...	124	111	113	112	113

The ratios in Table XI show that whereas male mortality at ages 20–65 in 1930–32 ranged from 90 for Class I to 111 for Class V, that of married women had a wider range from 81 to 113, and the figures at 35–65 gave almost the same result. When divided by social class, therefore, married women have a mortality range about 1½ times that of men, a similar result to that found when division of areas was made according to their overcrowding indices, which are fairly closely correlated with social class distributions of the population.* Remembering that the social class mortality of men is influenced by the direct effects of the occupations composing the social classes added to the indirect effects which influence also their wives, it is evident that the contribution made by the actual work done to the men's social mortality gradient from all causes must be very small compared with the contribution made by the accompanying environmental, economic or selective factors.

With regard to the diminution in range of male mortality from 82–124 in 1921–23 to 90–111 in 1930–32, it must suffice to say that this is only in part accounted for by the inclusion of non-civilians and other changes in classification. A discussion of the reasons for this remarkable change will be found in the Report.

When separate causes of death are considered, the social class gradients apparent in male mortality are also found to a no less degree in the married women's mortality for most diseases, and it is only possible here to mention some of the outstanding exceptions to this generalization, which are shown in Table XII.†

Cancer mortality as a whole shows a much slighter social gradient for married women than for men, but it cannot be deduced from this that the direct effects of occupation are responsible, since the gradients are very different, and may even be in opposite directions, for cancer of different sites, and the distribution of cancer by site is by no means the same for the two sexes. Diabetes mortality falls rapidly from Classes I–II to Class V amongst males, but the natural anticipation that married women would also show a similar excess in the more affluent classes is not realized, this being a matter of considerable interest. Mortality assigned to insanity, excluding general paralysis of the insane, is much higher in Class V than in Classes I–II for men, but for married women the class differences are much less pronounced. Cerebral hæmorrhage and nephritis show a complete reversal of gradient for married women compared with men, and for angina pectoris and appendicitis the downward gradient from Classes I–II to Class V is much steeper for the men than for the women. Gallstones and gall-bladder diseases show a

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* Housing index correlated with proportion of males over 14 in Classes IV–V in the county boroughs in 1931 gives a correlation coefficient $r = 0{\cdot}67$ (see Registrar-General's Review for 1934, text, p. 151).

† This comparison is not invalidated by the use of a different series of standard rates for calculation of the male and female ratios respectively, for, as will be shown in the Report, standardization of both mortalities by the *same* series of standard rates leads to figures not appreciably different in their relative values from those here shown.

TABLE XII

Comparison of Mortality Variation according to Social Class amongst Males and Married Women for Certain Causes of Death, 1930–32

	Males or Married Women	Standardized Mortality Ratios at Ages 35–65 in the Social Class Specified.			
		I–II	III	IV	V
Cancer (all sites)	M	91	99	102	114
	M.W.	97	102	95	105
Diabetes	M	155	97	75	62
	M.W.	85	104	109	106
Insanity (not G.P.I.)	M	73	101	90	131
	M.W.	91	98	81	102
Cerebral hæmorrhage	M	107	101	96	96
	M.W.	88	101	108	110
Angina pectoris	M	161	95	66	67
	M.W.	130	93	84	89
Appendicitis	M	150	95	78	74
	M.W.	120	101	89	77
Hernia	M	79	99	121	111
	M.W.	58	96	126	152
Gallstones, gall-bladder disease ...	M	160	92	79	66
	M.W.	101	97	110	101
Nephritis	M	121	96	88	94
	M.W.	90	99	103	115
Accidental causes	M	71	101	127	103
	M.W.	93	95	100	111

steep fall in mortality from Classes I–II to V for men, but no social class differentiation for married women, whereas hernia, it is rather surprising to find, shows a greater class differentiation amongst the women. Accidental causes, as might be expected, are more affected by social grading amongst the men than amongst the wives, the direct effects of occupation being here apparent.

These examples suffice to indicate the curious fact—suspected perhaps but not, I think, demonstrated before that social affluence is more dangerous to men than to their wives, because it tends to bring in its train enhanced mortality from diabetes, apoplexy, nephritis and gallstones, and to increase their mortality from angina pectoris, appendicitis, cirrhosis of the liver and suicide to a greater degree than is the case amongst their wives. From the poverty diseases, however, the married women suffer similar handicaps to the men through poor social circumstances, and it is because for the wives the many advantages of affluence are not offset by such disadvantages as it confers upon men that they show the steeper social class gradient of mortality from all causes referred to in Table XI. Whereas in Class V the men's standardized mortality at ages 35-65 was 40 per cent. higher than that of married women, in Class I it was 55 per cent. higher. For further evidence on this matter reference must be made to the Occupational Mortality Report.

We must pass on to consider by a few examples the use which can be made of this method to decide whether an excess of mortality from some cause exhibited by men of a particular occupation represents a true occupational risk, or is attributable to the accompanying environment. In Tables XIII and XIV the standardized mortality ratio at ages 35–65 for males of the specified occupation is first given (the figure for all males being taken as 100), and then the S.M.R. at the same ages for married women whose husbands were of that occupation (the figure for all married women being taken as 100). In the third column the ratio of male to married women's standardized mortality has first been obtained (using for the purposes of this ratio the *same* series of standard rates for the calculation in each instance—namely, the rates for all males at the three ages, 35–, 45–, 55–65) and the resulting ratio for the occupation and cause in question has then been divided by the corresponding ratio for all males in terms of all married women. The resulting index can be approximately reached by simply dividing the male S.M.R. by that of the wives, although different sets of standard rates are used for the computation of these two figures. The index signifies, by its excess or defect from unity, to what extent the mortality of men engaged in the occupation is affected over and above that of married women who share the general environmental handicaps or advantages of the group. A selection of the more important causes of death has been shown in these tables, but in the Report division into some 50 causes has been made.

In a few occupations the wife may be partly involved in the direct effects of her husband's occupation by assisting in it, and examples are first given in Table XIII of the mortality pictures of two important occupations of this kind, those of farmer and innkeeper.

Farming confers, through its localization in the country, some measure of survival advantage upon farmers' wives, but the farmers themselves also enjoy an even greater relative advantage, suggesting that the work they do is in itself beneficial, apart from the healthy environment of their farms. This applies most strongly to phthisis, peptic ulcer, bronchitis and pneumonia, which give relative indices as low as 0·54, 0·60, 0·67 and 0·70. The causes of death which stand out from the list as apparently affecting farmers to an appreciably greater extent than their wives are suicide, diabetes, diseases of the blood and nephritis, and the statistical significance of the excess in each case can be tested by means of the approximate formula for the standard error of a standardized mor-

TABLE XIII

Standardized Mortality at Ages 35–65 *of Farmers and Innkeepers compared with that of the Wives of Men in the same Occupations,* 1930–32

Cause of Death	Farmers			Inn- and Hotel-keepers		
	S.M.R. of Men (all Males = 100)	S.M.R. of Wives (all Married Women = 100)	Men's Mortality Ratio in Terms of that of Wives	S.M.R. of Men (all Males = 100)	S.M.R. of Wives (all Married Women = 100)	Men's Mortality Ratio in Terms of that of Wives
All causes	73	90	0·82	156	118	1·33
Influenza	98	119	0·81	138	127	1·10
Respiratory tuberculosis	34	64	0·54	152	108	1·45
Cancer	73	90	0·84	140	107	1·33
Diabetes	131	93	1·39	333	116	2·74
Diseases of the Blood	126	115	1·10	108	96	1·13
Cerebral hæmorrhage	68	86	0·80	207	163	1·26
Heart diseases ...	77	86	0·91	144	104	1·40
Bronchitis	35	50	0·67	93	100	0·91
Pneumonia ...	55	78	0·70	127	103	1·24
Peptic ulcer ...	63	103	0·60	142	162	0·84
Cirrhosis of liver ...	80	*55*	—	1153	814	1·46
Nephritis	94	88	1·07	233	171	1·37
Suicide	138	86	1·63	240	179	1·39
Accident	88	83	1·01	79	105	0·70

Italic figures are based upon less than twenty registered deaths, and no ratios of men's to married women's mortality have been calculated in such cases.

* In order to obtain these indices both male and married women's experiences at ages 35–65 have been standardized on the basis of the 1930–32 mortality of all males, and the resulting ratio divided by the corresponding ratio for all males to all married women.

tality ratio as suggested by Yule in his paper to this Society[†]—namely, standard error of S.M.R. = $\text{S.M.R.}/\sqrt{\text{number of registered deaths}}$. The registered deaths at 35–65 of farmers from the four causes were 281, 105, 98 and 287 respectively and the S.M.R.'s with their standard errors were, therefore, 138 ± 8·2 for suicide, 131 ± 12·8 for diabetes, 126 ± 12·7 for blood diseases and 94 ± 5·5 for nephritis. Comparing these with the S.M.R.'s for wives, which have standard errors of similar order, the male excess for suicide is evidently significant, but those for blood diseases and nephritis are not, whilst for diabetes the married women's S.M.R. is 93 ± 10·2, giving a significant male excess if twice the standard error of the difference is used as the criterion of significance. For diseases of the blood, however, both farmers and their wives show an excess over the average mortality of all males and all married women, which for the men is statistically significant, and remembering that the wives share to some degree in their husband's occupation, this excess may be occupational in origin. We may therefore conclude that, of the causes shown, the true occupational risks are suicide (in common with most occupations whose remuneration fluctuates greatly at the mercy of uncontrollable circumstances), diabetes and perhaps diseases of the blood.

[†] On some points relating to vital statistics, more especially statistics of occupational mortality: G. Udny Yule, *Journal of Royal Statistical Society*, XCVII, 1934, p. 29.

Inn- and hotel-keepers involve their wives, either through selection, environment, opportunity or example, or through actual participation in the husband's occupation, in an excess of mortality above the average for married women, amounting to about a third of the excess suffered by the men themselves. The causes which contribute chiefly to the wives' excess, and for which their S.M.R. is significantly above 100, are cirrhosis of the liver with S.M.R. of 814, based on 57 compared with 7 calculated deaths, cerebral hæmorrhage, nephritis and suicide. When comparison is made between the men and their wives, the causes with significant relative excess for the men are diabetes, respiratory tuberculosis, heart diseases, cancer, cirrhosis of the liver and nephritis, and these may be regarded as true occupational risks. Peptic ulcer, which shows a significant excess over the standard expectation for the men and an equally great excess for the wives, and also pneumonia, which shows a significant excess for the men but no appreciable excess for the wives, must also be added.

Table XIV shows a similar comparison for two skilled occupations in social Class III known to present an excess of mortality over that of their class which amounted in 1930–32 to about 30 per cent., the S.M.R. for all males of Class III being 97. In each instance it has been assumed hitherto that the excess was of occupational origin, but comparison with the married women's mortality modifies this view in the case of furnacemen whose total mortality is reflected in that of their wives. The only causes shown in the table for which furnacemen's mortality is enhanced to a significantly greater extent than that of their wives are acute pneumonia, with S.M.R. 139 ± 15·7 and cancer of the mouth and pharynx, 250 ± 45·6. These causes, with the probable addition of cancer of the lung with S.M.R. 178 ± 44·5, may be regarded as the chief occupational risks, but they only account for 47 out of the 201 deaths in excess of the standard number, and the bulk of the excess in this occupation must be attributed to its predominantly northern and urban distribution, and to the unhealthy residential conditions which the iron and steel

TABLE XIV

Standardized Mortality at Ages 35–65 *of Furnacemen and Stone-masons compared with that of the Wives of Men in the same Occupations,* 1930–32

Cause of Death	Furnacemen, Rollers and their Skilled Assistants			Masons, Stonecutters, Dressers and Carvers		
	S.M.R. of Men (all Males = 100)	S.M.R. of Wives (all Married Women = 100)	Men's Mortality Ratio in Terms of that of Wives	S.M.R. of Men (all Males = 100)	S.M.R. of Wives (all Married Women = 100)	Men's Mortality Ratio in Terms of that of Wives
All causes	126	125	1·01	125	107	1·18
Influenza	123	*109*	—	156	*129*	—
Respiratory tuberculosis	109	113	0·93	220	110	2·10
Bronchitis and asthma	161	*220*	—	154	*107*	—
Chronic interstitial pneumonia; silicosis	*50*	—	—	1950	—	—
Other pneumonia ...	139	*79*	—	95	*86*	—
Cancer of mouth and pharynx ...	250	*100*	—	*112*	*150*	—
Cancer of œsophagus and stomach	149	133	1·06	106	155	0·67
Cancer of lung ...	*178*	*50*	—	*109*	*50*	—
Cerebral hæmorrhage	152	147	1·01	97	114	0·86
Heart diseases ...	129	140	0·90	121	102	1·20
Diseases of digestive system ...	128	121	1·00	70	91	0·72
Nephritis	115	143	0·81	105	154	0·68
Accident	70	*50*	—	149	*100*	—

Italic figures are based upon less than 20 registered deaths, and no ratios of men's to married women's mortality have been calculated in such cases.

* In order to obtain these indices both male and married women's experiences at ages 35–65 have been standardized on the basis of the 1930–32 mortality of all males, and the resulting ratio divided by the corresponding ratio for all males to all married women.

industry has generally produced, factors which affect the wives as seriously as the men.

Stone-masons, on the other hand, present a different mortality picture. Their wives' total mortality ratio of 107 is not significantly above that of all married women of Class III (100), the only cause with significant excess over the standard deaths being nephritis with S.M.R. 154 ± 24·4. The men's ratio for nephritis was normal, and that for all married women of Class III was 99; no explanation can be suggested for the wives' excess from this cause. The wives' ratio of 155 ± 27·8 for cancer of the œsophagus and stomach is not significantly in excess of that for all married women of Class III (105), and the men show no appreciable excess from this cause. The men's mortality was significantly above that of all males for influenza (S.M.R. 156 ± 25·0), phthisis (220 ± 15·6), silicosis or chronic interstitial pneumonia, for which 39 deaths were registered at 35–65, compared with two standard deaths giving the very high S.M.R. of 1,950, bronchitis and asthma (154 ± 20·4), heart diseases (121 ± 8·3) and accident (149 ± 20·7). When comparison is made with the wives' ratios as basis, the excess for influenza, bronchitis and heart diseases becomes of doubtful significance. The occupational risks which are clearly indicated for stone-masons are therefore silicosis, phthisis and accident, which accounted for 162 out of the total of 225 deaths in excess of the standard expectation, leaving a standardized mortality of 108 for all other causes. If bronchitis and asthma are included also as secondary respiratory affections whose excess of mortality is almost certainly of real occupational significance here, the S.M.R. for the remaining causes is further reduced to 106. This group of men provides a good example of an occupation exposed to two specific occupational risks of dust inhalation and accident, apart from which it does not impose unhealthy conditions of life, either upon the men themselves or upon their wives.

These few examples must suffice to illustrate the uses of the mortality analysis of wives of men in different social classes and occupations, not only as control groups for the men's mortality, but also as affording a means of measuring the influence of social factors upon women's health apart from the immediate effects of occupation in itself. I trust that sufficient indication has been given of the lines which have been followed in the 1930–32 occupational mortality report to make it possible for those who take part in the discussion to make some criticisms or suggestions which may be helpful in planning the 1941 enquiry, and in particular to suggest to what extent any further subdivision of occupational deaths according to the industry and the locality is likely to be of value.

DISCUSSION ON DR. STOCKS'S PAPER

PROFESSOR GREENWOOD: There can be no doubt either of the importance of the subject of Dr. Stocks's paper or of Dr. Stocks's special competence to handle the subject. Before entering upon the discussion, I think it impossible to avoid a comment on the opening paragraph of the paper. So far as Dr. Stocks himself is concerned, the apology for a somewhat meagre use of recent data is complete and satisfactory, and the departmental practice of refusing permission for the publication of data in advance of departmental publication is of long standing. It is, however, an arguable point that this rule is too rigidly applied. Presumably the original motives were twofold: (1) That it could not be in the public interest to permit individuals, with perhaps tendentious motives, to make capital of information possibly incomplete and liable to create false impressions. (2) That it was unfair to public departments to allow individuals to profit by laborious investigations made at the public cost, and perhaps obtain unjustified credit for scientific work not in fact done by them. I am not, however, quite sure how far that applies to the discussion of a subject of this kind at a scientific society. I for one should be the last person in the world to wish to deprive the scientific servants of the State of full credit for their researches, but the public has a claim to consideration. It is of importance to interest the public in such researches as those under discussion, and many may be apt to feel that the "news" of 1931–2, not to speak of 1861, is rather cold.

Passing to the extremely interesting matter put before us, the first point Dr. Stocks makes is that he is perplexed by the comparatively little use Farr made of his data. I am equally perplexed, but I believe it may have been for this reason. It is possible that Farr shied a little from the difficulty of small numbers. As far as I can recollect, Farr never used any of such "probable error" tests as were current in his day, but he had a remarkable instinct for keeping right and not using data that were not adequate to sustain an argument. Another possible reason was that the inevitable confusion of industry and occupation was in his mind. It seems to me likely that he felt more interest in "featuring," as we say in the modern newspaper, what seemed to him simpler factors of mortality. He probably had not, wide as his intellectual range was, much knowledge of the detail of occupational life.

Ogle's neglect of the subject was, I think, attributable to his profound scepticism as to the value of the data: reading between the lines, or indeed often *in* the lines of his report on the 1880–82 data (supplement to 45th A.R.), it is clear that he profoundly distrusted the data, although he did bring himself to conclude that "after the fullest weight had been allowed to all the defects which had now been mentioned, there could be no reasonable doubt but that the death-rates did in reality furnish valuable indications of the comparative salubrity of different industrial occupations" (*op. cit.*, p. xxiv).

Dr. Tatham was preoccupied with the town/country comparison, but was not much interested in the occupational question. It was really to Dr. Stevenson that we owe the fact that the occupational as distinct from the industrial classification has secured its rightful primacy, and his successor, Dr. Stocks, has done much in this direction also. This was evident in the last three decennial supplements.

The chief scientific problem Dr. Stocks has considered is the isolation of a directly occupational effect on rate of mortality. The position is that occupation, economic status and geographical position all influence the rate of mortality, and that it is impracticable to isolate experimentally the first of the three variables. Some statistical method of elimination must be used.

The first step was taken in 1910–12, when economic or social status was brought into consideration, and this classification was considerably improved in 1921–3. If the method of classification were perfect, and if mortality depended wholly upon economic status, both unreasonable assumptions, the variability of mortality within each social class would be small. It is actually (using 1921–3 data) large: the coefficients of variation range between 41·6 per cent. in Class V and 26·3 per cent. in Class III. The next step is to consider geographical situation. To this Dr. Stocks has paid great attention, and has to some extent separated latitude and housing conditions. But this study is indirect, and if indices of situation and housing density were introduced into the occupational analysis, one would be obliged to resort to a very detailed geographical sub-tabulation. Hence the desirability of confronting the rate of mortality on occupied males with the rates on members of their families. Already in 1921–3 the rates of infant mortality were tabulated by occupation of fathers. Now we have the rates of mortality of married women. Evidently the rates of mortality of infants and wives must depend rather on the economic and geographical correlates of occupation than on the nature of the occupation. Dr. Stocks's researches published in the Registrar-General's *Annual Reviews* suggest that the mortality of children is particularly sensitive to housing conditions, some of the results in this paper imply that the mortality of wives must be sensitive to general economic factors. Of course in neither case is an occupational effect wholly excluded—viz., the influence of the occupation of the mother—but the argument relied on is that this is, in general, only a small factor. To an old-fashioned statistician like me, there is a temptation to try to express the rate of occupational mortality in terms of infant mortality, mortality of wives and social index by means of a regression equation. But I have considerable doubts whether the result would be of much value. The geographical factor is ignored, and Dr. Stocks shows that it is very far from being negligible. Perhaps, however, the method might be of some use applied regionally. Again, an old-fashioned statistician, particularly if he sat at the feet of Karl Pearson, is a little worried about the problem of selection. Suppose one has two occupations, *A* and *B*, and that both occupied males and their wives in *B* have the same percentage excess of mortality over occupied males and wives in *A*. *Does* it logically follow that the excess mortality on *B* males is independent of occupation? I think this would not be so if, for instance, occupation *A* requires a higher degree of physical selection; we should then expect the percentage excess of *B* males to be less than that of their wives. However, of the value of the new information there can be no doubt.

In conclusion, I have great pleasure in moving a very hearty vote of thanks to Dr. Stocks for his extremely interesting paper.

MR. G. S. W. EPPS: It is, I think, very fitting that at intervals corresponding with each censal period this Society should have an authoritative paper by one of the responsible officers on the staff of the Registrar-General, and we are indeed indebted to Dr. Stocks for taking over the torch from Dr. Stevenson. As the author says, he has been hampered by the fact that his paper had to be read before the publication of the official report on occupational mortality, but he has succeeded in giving us a paper raising a number of important points for discussion.

The absence of the official report is an even greater disadvantage to one who has to discuss this paper. Without the data on which the paper is based, it is frequently difficult to assess the statistical significance of certain of the figures shown in the tables or the effect of the assumptions made in applying the procedure for standardization of which much use is made in the paper. For example, in Table VII the first column, headed " All Males," may be the result of applying to the total population of the region the rates of mortality for the whole country, or it may have been derived by aggregating the expected deaths for each of the five classes calculated by applying to the populations of each class the rate of mortality for that class in England and Wales, and comparing the total thus obtained with the actual deaths occurring in the Region. I presume from the footnote to the column, where the author indicates that corrections have been made for social class as well as age, the latter method was followed. I may, however, remark that by comparing the expected deaths calculated by the English Life Table No. 10 with the actual deaths, I have been able to reproduce exactly the percentages in the first column, which is virtually the first method.

As an instance of the uncertainty as to how far the figures are of sufficient magnitude to produce a significant result, I would instance the percentage of 79 for Social Group I in North II. The figure seems rather out of scale in a table which generally shows marked consistency, and may be unduly low owing to the fact that the numbers to which it relates are relatively small; similarly the high mortality figure—viz., 128—for Social Class IV in South-East Region. In passing the paper finally for press, the author may feel the need for extending the cautionary words on this subject included in relation to Table VIII.

Throughout the paper the author has adopted standardization of mortality rates in order to make the various divisions of the data comparable. No doubt he has satisfied himself as to the appropriateness of the particular methods, which must necessarily be empirical, for the purpose in view. But in interpreting results it has always to be borne in mind that in expressing the mortality of a particular section of the community by a single index figure, material variations over ranges of ages may thereby be obscured.

Take, for example, the standardized rates for county boroughs for all males, aged 20 to 65, in Table VII—viz., 120 for North I and 125 for North IV. On referring to Sir Alfred Watson's Report on Life Tables (Registrar-General's *Decennial Supplement England and Wales*, 1931), it is interesting to observe that in Appendix III, where for each quinary group of ages the mortality rates for the same regional groups are compared, taking as a standard England and Wales as a whole, the slopes of the curves in the two areas cited are markedly different. In North I, following a much heavier excess among children and adolescents—about 40 per cent. over the standard compared with 20 in North IV—by middle life the relative excess has disappeared, and the position is actually reversed at the later adult working ages.

The rate of mortality in any section of the community is affected by a large number of factors, and I gather that the main object which the author has had in view in preparing the principal section of this paper is to attempt to segregate certain of these factors, and so obtain a measure of the influence of each variable—*e.g.*, occupation, geographical situation (which perhaps counts the same as climate), urbanization and social status. While it may be doubtful whether it will ever be possible to isolate completely the effect of any one of these influences from the others, a series of researches such as the present should enable some valuable conclusions to be drawn.

The control test by comparing the mortality of the wives with that of the husbands of the same social class in the same area is an interesting attempt to eliminate the effects of occupation, but it would appear from Table VII that the influence of occupation on mortality is not so important as, for example, geographical situation. It seems to be a well-established fact that the northern section of England experiences considerably heavier mortality than the south, and it would almost appear that the mortality tends to become heavier the farther north one goes. Incidentally it may be mentioned that for Scotland generally, even excluding Glasgow, the death-rate is considerably higher than in England and Wales. Taking even well-defined classes, such as school-teachers and the police, it is found that in Scotland the mortality is considerably heavier than in England. It might be suggested that the differences in the climatic conditions between the north and the south would not seem to be so considerable as to justify the divergence in the rates of mortality experienced, and I throw out the suggestion that underlying the superimposed influences of occupation, housing, and social classes, the fundamental cause of the difference may be racial characteristics.

Opportunities similar to those for examining the mortality of teachers and police, which arose in connection with certain investigations as to the cost of their superannuation schemes, will arise for municipal officers throughout the country, owing to the fact that under a recently passed Act superannuation has been made compulsory for every Local Authority, and arrangements will be made to collect statistics in due course in order to obtain an indication of the mortality experience of this special class of the population living under very similar conditions as regards employment, but in different areas.

Investigations of this nature relating to groups of individuals, homogeneous as regards occupation, social class and mode of recruitment, but located in different areas of the country, afford an alternative method of approach to that adopted in the paper, in the measurement of such influences as geographical situation and environment.

Dr. Stocks has provided us with a paper which testifies not only to his intimate acquaintance with the mortality conditions in the several areas of the country, but also to his public spirit in undertaking so elaborate an investigation. The Society is very grateful to him, and I have much pleasure in seconding the vote of thanks.

Sir Ernest Graham-Little felt he had no right to speak at the meeting : a Member of Parliament was the least scientific of men, and he was the least scientific of Members of Parliament. What had struck him in this very interesting discussion was that, if he had understood a very difficult paper aright, it would seem that the diminished importance which appeared to be attached to the occupational trend of causes conflicted with the experience of the practising physician not in mortality but in illness, illness being defined as causing a lack of opportunities of employment.

In the practice of that complicated Act, the Factories Act, which went through Parliament a few months ago, it was very instructive to see that a large importance was attached to local causes of disability which nevertheless created a very considerable degree of unemployment. This paper was confined to the issue of mortality, and he felt he might be out of order in saying anything about the other aspect, but to him it was a considerable eye-opener to see how extremely important even in that aspect might be the other causes to which too little attention had been paid. The examining surgeon had to say straight off if a man's illness was due to this or that cause, and he thought the attention of the surgeon was more concentrated than was right on these local exciting causes. How far one might have to modify these impressions by considerations as brought forward in the paper would be of important interest. The paper was full of information, but it seemed to him to open up a large number of new aspects, although he was very ill-informed upon these matters.

Dr. Bradford Hill said this paper seemed to augur well for the Registrar-General's 1930–32 Occupational Supplement, for which medical statisticians were waiting patiently. Dr. Stocks would clearly have no difficulty in maintaining the high standard set by his predecessors. In the present paper he effectively discussed the difficulties of isolating the influences of occupation from those, such as locality and the standard of living, which also affected mortality, and he pointed out how the control group of wives of differently occupied males might provide an effective means of reducing those difficulties. There were, of course, instances in which the experience of males alone might give a conclusive answer to a question, perhaps a clearer answer than comparison with their womenfolk, in spite of the localization of an industry. For example, in the cotton industry the experience of the workers in the cardroom showed that in 1921–23 they had a higher mortality from respiratory diseases than the workers in the spinning-rooms. The spinners here seemed to provide a completely effective control on the location and the general conditions of life, and made it reasonable to deduce that the excess respiratory mortality in the cardroom was due to the dustier conditions of that part of the cotton-mill.

Similarly, subdivision of workers in the pottery industry had allowed detection of the silicosis risks, although in some groups the numbers after such subdivision became very small. He believed, however, that only by such subdivisions into small groups could one hope sometimes to reveal occupational risks and, like it or not, they must face the statistical risk of operating on small numbers.

For instance, in Table III Dr. Stocks showed that the excess of respiratory mortality in miners in South Wales as compared with miners in Notts and Derby was also present in non-miners and amongst females, so that no special mining risk in South Wales was indicated. But available figures for silicosis claims strongly suggested that there was a greater risk in South Wales than in Notts and Derby; also in South Wales the claims increased as one passed from the steam coal-field in the east to the anthracite mines in the west. By taking that area as one unit heterogeneous material was put together, and possibly a real difference in mortality might be obscured thereby—in the same way as the industrial classification of 1910–12 obscured risks which were well brought out in the 1921–23 Supplement.

While the wives of occupied men would in general form an effective control, Dr. Bradford Hill thought attention would certainly have to be paid to the question of selection raised by Professor Greenwood. That in certain instances might be quite important. For example, Dr. Stocks concluded from the relatively lower death-rates of farmers, as compared with the corresponding relative position of their wives, that their occupation in itself was beneficial; but it was possible that the men who took up farming were originally more highly selected physically than their wives. Similarly the men in the rolling-mills might be selected for their physique, and therefore should have a relatively more favourable position than their wives. Sex equality in the relative mortality positions would then be a point against these workmen, not an indication of no occupational disadvantages.

Dr. Stocks had asked for suggestions or criticisms for the 1941 report, and Dr. Bradford Hill had two points in this connection. The first was that it might be possible for the Registrar-General to publish or at least tabulate in his own Department the basic figures —populations and deaths by causes—for rather small but occupationally important groups, and to see whether in two or three adjacent *Supplements* the rates resulting from those figures confirmed one another, or whether by appropriate addition a firmer basis for conclusions could be reached. His second comment was in the nature of a plea relating to the time interval between collection of data and publication which had already been referred to.

In 1938, if he were approached by an earnest seeker after truth for information as to occupational mortality in this country, he had to refer him to the Report of 1921–23. The Report to be published this year related to deaths of which the last was recorded in 1932.

He asked if it were not possible for the Registrar-General to follow with these mortality figures the same procedure as he did with his annual reports—viz., to issue the basic data as early as possible, and later to publish the careful and admirable studies which he himself made upon such data.

Mr. F. J. C. Honey thought that Dr. Stocks in his interesting paper had shown very clearly the care necessary to avoid drawing fallacious conclusions from occupational mortality figures. In some respects he would go rather further than Dr. Stocks had done: for instance, Dr. Stocks appeared to accept the standardized mortality ratio as a completely valid means of comparison. But the population chosen as a standard made a considerable difference to the result obtained, particularly when one was interested in the actual percentage excess of mortality shown by occupation *A* over that for occupation *B*. Where the shapes of the two mortality curves were materially different, it might even be that on one basis occupation *A* showed heavier mortality than *B*, while on another—equally valid—basis the reverse would be the case. It was never easy to compare two sets of mortality data, but he did not think that any single index could ever be completely satisfactory. It seemed to him that if a single index figure must be used, the most satisfactory basis was the Life Table death-rate, though that was often inconvenient to calculate.

Professor Greenwood had referred to Dr. Ogle's scepticism about the fundamental data, and he must confess to a similar doubt, particularly in the case of the latest figures of 1930–32. That was a specially unfortunate time as the rate of unemployment amongst insured men was over 20 per cent. in those three years, and that would enhance the chances of a different classification of the same men in the census and the death registers. The great changes in the relative size of various industries since the war must affect the occupational mortality figures. Some industries had shrunk by 40 per cent., others had expanded; and there must have been many men included amongst the deaths of 1930–32 who were employed at the time of their death in an occupation quite other than that in which they had grown up, and to the risks of which they had been subject most of their lives. The changes in the relative numbers employed in various industries were going on at an increased rate in 1930–32, owing to the industrial depression, leaving the gold standard, and the general tariff imposed in March 1932. He therefore doubted whether the 1931 census would give a fair figure for the "exposed to risk" in a number of occupations. The average age amongst the deaths would be higher than amongst the living, and there would be a much larger chance of people having changed their jobs amongst those who died in 1930–32 than amongst those forming the denominator of the fraction. While he did not suggest that in no case could valid comparisons be made, he wished to emphasize the care necessary in considering the significance of the figures.

His remarks were merely by way of qualification and he wished to join in the thanks offered to Dr. Stocks for his most interesting and valuable paper.

THE HON. SECRETARY read the following letter from Mr. Udny Yule: "As I cannot come to the meeting, I must at least send a line to express my sense of the great interest of Dr. Stocks's paper. The new method of comparing relative mortality of men engaged in a given occupation with that of their wives is clearly going to throw quite a new light on matters, to lead not infrequently to most unexpected results and thence to raise further questions. It seems to me by far the most important advance for a long time in methods for the study of occupational mortality."

DR. KANTOROWITSCH, after the Meeting, wrote as follows:—

The reason why I, though a foreigner, do not abstain from participating in a discussion on a paper based on an official report and read by a person charged with the preparation of this report, is solely because we on the Continent have been as much dependent on the material provided by the "Decennial Supplements" as investigators of this country. It was therefore a great pleasure to me not only to listen to Dr. Stocks's paper but also to re-read it most carefully after the meeting. Passages on page 672 relating to differences in the mortality of coal-miners in different counties were particularly interesting to me as I had some correspondence about just this question (apart from others, such as the mortality of tin-miners, etc.) with Prof. Edgar L. Collis as long ago as the year 1924. As my copies of the correspondence have accidentally been destroyed, I must quote a passage from a piece of work of mine concluded early in 1925. After I had pointed out that the tuberculosis-mortality of coal-miners of England and Wales does not correspond with that in other countries, I wrote (in German):

> The cause of the different mortality is to be sought in the different kind of coal-mines. Prof. E. L. Collis did not agree with my opinion that the cause of different mortality might be explained by the difference in social and economic conditions, nor did he share my surmise that the cause might be the different climatic and geographical conditions. To his mind the cause must be dependent on the difference in the geological formation of the different coal-fields and particularly in the silica content, or some other mineral, contained in the coal worked and in the roof of the workings which, according to his theory, would account for the variation in the mortality from phthisis and other respiratory diseases.

Now it seems that I was not so wrong in my surmise; but more important appears the fact

> "that the 17 per cent. excess of mortality for Lancashire miners over that of the Nottingham and Derby miners in 1930–32 was matched by a 19 per cent. excess for other persons resident in the same counties" (p. 673).

Incidentally the results of an enquiry by the Economic Research Section of Manchester University into conditions of work of Lancashire children have lately been published, and indicate that juvenile labour conditions in Lancashire seem to be particularly unfavourable to health.* Bearing the results of this enquiry in mind, I cannot but agree with Dr. Stocks's opinion that the difference between the mortality in Lancashire and that in Nottingham and Derby "is unlikely to be occupational in origin."

It seems to me that this comparison throws some light upon the very difficult question of how to eliminate as far as possible the occupational from other environmental conditions. I am inclined to believe that social surveys might play a considerable rôle in the investigations concerned, and in any case those who have expressed their opinion that a quinquennial Census would make social surveys superfluous † should consider whether on the contrary social surveys may not serve as a valuable supplement to statistical investigation, provided that the investigators can distinguish random from "biased" sampling. If I may be allowed to make one or two other remarks, it appears that the age-group 20–25 has been included in the Report in spite of Mr. Yule's warning in the paper mentioned by Dr. Stocks. The inclusion of this age-group is particularly inadvisable for the years 1930–32, inasmuch as those of this age-group were in the stage of their constitutional development during the years 1916–1918. Referring to p. 673, am I right in understanding Dr. Stocks to have asserted that the housing conditions of agricultural labourers in this country are more favourable than those of industrial labourers? My investigation in Germany showed that there, at all events, the agricultural labourer lives in much worse conditions than his industrial colleague.

Finally, it would to my mind be of great importance to know whether in interpreting the results it was borne in mind that the years 1930–32 were the years of economic crisis?

DR. STOCKS said that he would like to thank everybody for the very kind way in which the paper had been received, and would avail himself of the privilege of considering the criticisms at greater leisure and offering his reply in the pages of the *Journal*. Dr. Stocks subsequently wrote: I think that answers to most of the points raised in the discussion will be found in the Decennial Supplement, which, I have every reason to expect, will be published before these remarks appear in print. Professor Greenwood has mentioned the infant mortality rate as an additional measure of the economic and geographical correlates of an occupation. In the Report not only has infant mortality again been analysed according to the parent's occupation and social class, but also the mortality of children in the second year of life, with some regional subdivision in each instance. Whilst neonatal mortality has a range of variation with social class very similar to that of married women, the mortality of children in the second year has a much wider range, the indices in terms of 100 for all classes being as follows for Classes I to V: married women 82, 90, 100, 103, 113; infants under 1 month 72, 90, 97, 106, 108; children aged 1–2 years 31, 50, 87, 108, 158. Dr. Elderton's researches showed how closely infant mortality in the first year was associated with the mother's health and we might therefore expect to find quite a high correlation between infant mortality and that of married women amongst different occupations of the husband, but not such a high correlation between mortality in the second year of life and that of married women. This has not been tested, but if it is found to be true I suggest that it might be more profitable to use the second year's mortality rather than the first as the third variable in Professor Greenwood's proposed regression equation.

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* Jewkes, John and Sylvia: The Juvenile Labour Market. London, Gollancz, 1938.

† *Vide* Discussion on Mr. D. Caradog Jones's paper on The Social Survey of Merseyside, in the JOURNAL, Part II, 1931.

I agree that the selective recruitment of men for certain occupations must, as Professor Greenwood and Dr. Bradford Hill point out, be borne in mind before drawing conclusions from ratios of the men's mortality to that of their wives, just as the possibility of the employment of considerable numbers of the wives themselves in certain occupational groups of the husband must be kept in mind. These warnings are given in the Report, but with regard to the selective factor I feel that selective mating may go a long way towards reducing the effect of it.

Mr. Epps finds some difficulty in the interpretation of the words "corrected for age and social class" at the foot of Table VII. The "all males" ratios are derived by aggregating the expected deaths for each of the 5 classes calculated by applying to the regional populations of each age within that class the rate of mortality for that class and age group in England and Wales, and comparing the total deaths thus obtained with the actual deaths which occurred in the region. The ratios are therefore corrected for differences both in the social class and age distributions of the regional populations. The figures for separate social classes in Table VII are in a few instances based upon rather small numbers of deaths, particularly those for Class I in such regions as North II and the East with few county boroughs. In the Report a test of significance is applied to the urban as well as the rural rates, but in extracting the material for this paper it was shown only for the rural ratios (Table VIII) where the problem of small numbers is more serious. The examples of anomalous ratios cited by Mr. Epps can be explained by variations due to random sampling. With regard to the northward increase in mortality which remains evident, as Mr. Epps points out, even within well-defined classes, and which he is inclined to attribute mainly to racial factors, I cannot help but feel that the combined effects of diminishing hours of sunshine, intensified by the smoke pall in the Lancashire–West Riding and Scottish industrial belts, and of the less satisfactory housing of persons of the same economic class on passing northwards, are sufficient to account for most of the northward gradient.

Dr. Bradford Hill mentions the great variations in silicosis prevalence in different parts of the South Wales coalfield and he will find that in the Report a separation has been made between the mortality of miners, below and above ground, in the anthracite pits and other pits of Glamorgan, and similarly for the combined counties of Brecknock, Carmarthen, and Pembroke. The standardized mortality ratios at 20–65 from all causes are found to be in each instance highest in the anthracite group, and a pronounced excess is found for phthisis and broncho-pneumonia when the anthracite miners below ground are compared with other coal miners below ground in the 4 counties. I am interested in the comments of Dr. Kantorowitsch on this matter. It has not been my intention to suggest that the health of coal-miners is in no way affected by the type of coal worked, but rather that the effects of this may be overshadowed by more important factors outside the mines when one coalfield is compared with another.

With regard to Dr. Bradford Hill's suggestion that the basic figures of occupational mortality might be published in advance of any textual explanation, this would not in my view be advisable, even if it were practicable. The issue of the tables of the present Report could not in fact have been expedited had such a plan been adopted. The number of machine processes through which the cards have to pass and the amount of cross checking of tables become greater for each Report. Moreover experience proves that the study of mortality based upon the statements of the last occupation on census schedules and birth- and death-certificates is beset by many pitfalls, some of which are only apparent to those reponsible for coding the occupations, whilst others only come to light during the preparation of the textual analysis. As outstanding examples of such difficulties thrown up by the crude figures may be cited the apparent mortalities in 1930–32 of skilled and unskilled workers in the building trade and of warehousemen and their assistants, single women's rates for social classes I and II and the low apparent mortality of young domestic servants. Every effort will be made to carry Dr. Bradford Hill's other suggestion for 1941 into effect in so far as the ever-increasing demands for detail allow.

Mr. Epps, Mr. Honey, and Dr. Kantorowitsch refer to the difficulties which arise in the attempt to express occupational mortality over a wide range of ages by a single figure, a problem which was examined very thoroughly by Mr. Udny Yule in the paper I have already quoted. The objections to the inclusion of the age-period 20–25 apply also, though with rather less force to the period 25–35, and if a figure is desired to cover the whole working life there is no justification for omitting either period. Moreover for single women the period 20–25 is important. These difficulties have been met in the Report by tabulating standardized mortality ratios both for the full range of ages 20–65 and for the more stable period 35–65. I think it must suffice to say here that in the introduction to the Report the validity of the S.M.R. has been carefully examined and that the calculation of alternative ratios limited to ages 35–65 throughout the Report provides in most instances an adequate safeguard against the disturbing effects of very abnormal age distributions of the populations at risk.

Dr. Kantorowitsch asks whether I meant to imply that the housing conditions of agricultural labourers are more favourable than those of industrial labourers. In speaking of the harmful effects of certain industries upon the housing of labourers I had in mind the crowding together of houses into streets where sunlight and air are restricted, and in this respect at least I believe that in England in 1930–32 the agricultural worker had on the whole the better environment.

With Mr. Honey's view that 1930–32 was an unfortunate time for the compilation of occupational mortality records owing to the industrial depression I have great sympathy. It is clear, of course, that the mere fact of temporary unemployment ought not to affect the statistics of occupation either at census or at death, since the *last* occupation is recorded. Nevertheless in a country where unemployment insurance and relief are in force it must happen that during a time of depression severely affecting certain industries the ranks of the unemployed in those industries tend to become overweighted with men who are below the normal in vigour and health, since the more vigorous types are more successful in finding employment elsewhere. There can be little doubt, for example, that the coal-miners' mortality rates in 1930–32 were adversely affected by such a selective movement away from the industry. Mr. Honey will find that attention has been paid to these matters in the Report.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society :—

George Goodall, M.A.
Charles Ronald Poole.
Stuart Mathias Taylor.

SOME FOOTNOTES TO HOUSING FIGURES

THE VALEDICTORY ADDRESS of the PRESIDENT, the RIGHT HON. LORD KENNET, P.C., G.B.E., D.S.O., D.S.C.

[Given before the ROYAL STATISTICAL SOCIETY, June 21st, 1938.]

A TRUE statistician, as I suppose, must not allow himself emotions of any kind. A layman, who is president of the Royal Statistical Society, must, during his term of office at any rate, behave as a true statistician, and, even on the occasion of his bidding farewell to his office, must deny himself the indulgence of his feelings. Were it not so, I should like to say how much pleasure, how much interest, I have had from the honour of being associated with the Royal Statistical Society during the two years of my office, and how sorry I am that the two years are over.

For your sake I cannot be sorry, for the dignity is passing to one most worthy to receive it, and the responsibility into hands most capable to bear it. Let me wish to Professor Bowley two years as pleasant as my two have been.

In the address with which I started my term, I spoke of the consumption of statistics. I dealt with the manner in which they are used, and the manner in which they ought to be used, by those who are responsible for the practical business of government.

On this occasion I may perhaps not inappropriately exemplify some of my theses on that former occasion by dealing with an instance of the relation between statistics and policy. I have chosen as an instance with which to deal one with which I have been familiar in the past, and one which seems to me to be likely to interest you, namely, housing matters. The idea came to me in reading the interesting paper on Urban Housing in England and Wales read at a meeting of the Society by Mr. L. R. Connor. A layman, I thought, cannot deal with statistical matters as an expert deals with them. Being a layman he must deal with them as a layman. His contribution must be to show you, as it were, how a layman reacts under the influence of statistics. If in doing so he travels further afield from the pure statistical fount than is usual in papers read to our Society, he must ask, and will I hope receive, your indulgence. *Ipsa ollera olla legit.* The meal the pot cooks for you must be the meal which it knows how to cook.

The statistical picture of the housing problem when I first came into contact with it in 1931 will be found amongst the earlier figures in Mr. Connor's paper. It was, as I saw it then, a picture unfinished in drawing, and with many of the tints left out which were needed to give it any likeness to reality. In framing policy there were many things which one wanted to know and which no statistician could tell one. One wanted to know more than one did about the real income of the wage-earner; about what part of it could be spared for rent; about the size of a wage-earner's family and the minimum accommodation proper for it; about how much accommodation there was in various parts of the country and at what price—in short, a census of houses. One wanted to know about the cost of building and the cost of money, and in particular, about their probable future.

Those unfamiliar with the business of government might suppose that information so essential was to be had before designing courses of action. A very short experience teaches us that that is not to be expected, and that legislators and administrators must do their best without such aids. It is indeed one of the natural laws of democracy that the exact information needed as a basis for policy is never available, and another is that there is never time to get it.

Knowledge was, of course, available in sample form about all these matters from various enquiries conducted by public and private agencies. Making what use I could of such knowledge I thought that the following statements were true in relation to the figures to which I have just referred.

1. Rapid as the increase of small dwellings had been, the new supply was not made sufficiently available for the lower-paid wage-earners.
2. The existing system of subsidies was actually reducing the rate of production of small houses for wage-earners.
3. An enormous amount of public money had been wasted in the past in subsidies unnecessarily large, and ill-directed.
4. Practically no progress at all was being made with slum clearance.

The first statement deals with a matter of fact—a fact which could be demonstrated only by enquiries into selected districts. There were no general figures available. Enquiries made it clear enough that the lower-paid wage-earners had profited little, or not at all, by the increase in the housing accommodation. The subsidized houses were, to a very large extent, occupied by the lower middle classes, black-coated labour, and well-paid artisans. These were not the classes which needed the help of subsidized rents for decent accommodation. In other words, the subsidies were being largely wasted.

The second statement was a deduction from the ordinary laws of supply and demand. Rare now are the conditions under which unsubsidized production can compete with production that is subsidized. For a time after the war the price of money and the cost of building had no doubt been so high as to make it impossible for private enterprise to supply on a commercial basis small houses at rents which the wage-earners could pay. But by 1931 these conditions had changed. Prices of building material and rates for money had by now fallen so far that it seemed all but certain that private enterprise could enter the field of small-house building on a commercial basis, but for one thing, and that was the competition of subsidized rents. There seemed no doubt that if that barrier of subsidized competition could be removed, and private enterprise could be brought on to the scene to help supply, the rate of supply would be very largely increased. The smaller force available directly to the State for supplying small houses was keeping out of the field the much larger force available in private enterprise.

The position as regards the slums was particularly interesting, because it was particularly intolerable. Most of our slums are the legacy of the eighteenth and first half of the nineteenth century. There are some earlier and some later, but the bulk of them dates from that 150 years. Their origin was in the haste and stupidity with which we provided accommodation for the industrial population which grew up with the growth of industrial systems. As usual, a great change came before people had thought out all that it implied, and industrial cities were piled together, without plan, without any idea at all as to the accommodation necessary for decent life, and without consideration of the amenities which make life worth while. One of the worst features of the situation is that in those days they had such good building material, and on the whole they built so well, that the dreary and insanitary warrens which they built have an unconscionably long life. It is a comforting reflection that whatever bad building is done now will not last one-fifth as long. We have now so many rules and regulations about new buildings that very little present building is structurally bad, however ugly it may be. I do not think it is true that we are now building slums, although we are creating some very ugly neighbourhoods. But when one does see a modern building that is structurally bad, one has the consolation of knowing that its defects are of a sort that supply their own remedy, because it will certainly fall down in twenty years or so. It will not be as bad as ever after 200 years, like some of the hovels which were built on the Tyne nearly 200 years ago.

Our slum problem was a problem of the central areas of industrial cities of any age, and of the older non-industrial towns. Slums of the latter type, much the less common, are the remains of residential areas built, it may be, as far back as the seventeenth or even the sixteenth century. They are particularly difficult to deal with, if only because in such areas we must often be reluctant to clear away buildings of historical interest and artistic beauty.

But they are a minor problem in comparison with the more recent slums of the great industrial cities. A slum area in these is typically a central area, made up of small and squalid dwellings, repeated with dreary uniformity, without intelligent planning as to drains, water, light, streets, gardens, open spaces, shop-areas, schools, and other public buildings. From the outset airless, lightless, waterless, with bad sanitation and no amenities or conveniences, with the passage of time they have become decayed, damp, over-crowded, dirty and verminous, the radiant centres of disease. The sites have in many cases become enormously valuable, and this is really the biggest factor in the problem of how to get rid of the slums when one has to rehouse on the site.

The first reason why we were making no progress in getting rid of them was this factor of expense in the cost of sites. The second was, that it was such a troublesome and thankless business. Human nature being what it is, local authorities preferred to proceed with the cheaper, easier, and more agreeable task of constructing model housing estates on the undeveloped areas round the outskirts of their towns.

This was the outline of the situation as it was revealed by such facts and figures as were available, and from it some conclusions could be drawn.

The first was that private enterprise could, and should, be brought upon the scene to help effectively in the supply of small houses; and the second was that, in order to do so, subsidies must be strictly confined to supplying whatever houses could not be supplied by private enterprise. It was necessary, on the one hand, to get value for the public money spent in subsidies, and, on the other hand, to free private enterprise from the obstacles of subsidized competition, which was keeping it out of the field of production. The chief sort of housing work needed which could not be done by private enterprise was clearing the slums and providing alternative accommodation. Private enterprise could not do that because of the expense involved.

Since that was so, it was necessary to provide housing authorities with the subsidies needed in order to enable them to deal with slum clearance; to make sure they had powers adequate for the purpose; and to stimulate them to undertake the task. It was essential, too, to make sure that the subsidized houses should be available for the slum-dwellers in particular, and in general for those, and those only, whose income made it difficult or impossible for them to obtain adequate accommodation at an unsubsidized rent.

This was the first stage, but there remained another and even bigger task, with which I will deal a little later.

It may be of interest to pause here for a moment, and describe some of the circumstances which embarrass one who seeks to relate public action on the large scale closely to facts and figures. Naturally enough in such a case the chief embarrassments arise from neglect of irrelevant sentiment. I know that my path here leads dangerously close to the edge of controversy. I hope that it will be understood that my intention, at least, is not to make propaganda, but only to write a note on the natural history of political man.

The principal sentimental obstacles to be encountered in such a task are those which are created by extremes of opinion. There is on one hand the extreme opinion that the State should never do anything, but that all should be left to the unrestricted forces of private enterprise. At the opposite extreme there is the opinion that nothing is done which is not done by the State. To this last form of opinion houses built by private enterprise do not exist, whatever the figures may say. In the other extreme of opinion, subsidies for housing cannot be necessary under any condition. To both alike, the middle opinion that both public and private enterprise have their necessary uses is equally disagreeable. However, common sense can never come to its own without running the gauntlet between opposed sensibilities. With the national budget so deeply involved in growing claims for expenditure, we could not go on wasting public money in subsidies from which we got no good, and we could not leave the housing problem unsolved. So action had to be taken, in spite of the outraged feelings of extremists and enthusiasts.

It was decided that the first change which was needed was to approach the housing problem from a direction opposite to that from which it had previously been approached. Previously it had always been considered that the presumption was that the houses needed could not be got except by subsidy. A general subsidy had been provided, and the legislature had then looked round to see whether there was any little part of the field which could be occupied by private enterprise. The converse manner of approach was that it should be assumed that private enterprise could provide all the houses which were needed, and at the required rents. One should then look round and see whether as regards any part of the supply required that assumption was false. If as regards any part one found that private enterprise could not provide the houses at the required rents, then there should be a subsidy adequate for the purpose, and the local authorities should be required to undertake the work.

To work out this mode of approach one had to have clear ideas about several essentials about which I do not think there had ever been any very clear idea before. The most important of them was the standard of rent to which we were to work. I took as the standard 10*s*. a week, for a house proper for an average wage-earner's family. That was a house of 760 square feet superficial area. It is not, of course suggested that this rent and this standard are good at all times and under all conditions. I will only maintain that it was a reasonable standard to which to work at that time and under those conditions; and at any rate it was not only a good thing, but it was a necessary thing, to have some idea in one's mind about what sort of house was wanted and at what rent.

As soon as the standard and rent were named, in public utterances, one understood at once why in the past others had cautiously avoided doing so. To mention any average figure of rent to which to work, or any average of accommodation considered suitable, was to expose a very wide surface to pressure.

Logic and facts have no more dangerous form of attack to fear, and none is more easily employed against them, than that which ignores the difference between an average and an individual case. If a statement be made about an average, at once, of course, innumerable particular cases can be produced which differ from the average, and by their means the original statement can be quite successfully discredited in popular discussions. If I say, for instance, that the power of the bray of the average ass is 100 decibels, some ass of exceptional lung-power is sure to say, "I bray with the power of 200 decibels, and so your statement is preposterous," and his fellow-asses will probably agree with him.

As a matter of fact, I think the 10*s*., 760 square-feet house was about the right house to take as normal, at that time, for our purpose; but however that may be, what is far more important was to have a fixed idea of what one wanted, and it is to the fixing of such an idea that I attribute a good deal of the success of the subsequent proceedings.

In order to feel safe in moving forward on the lines I am about to describe, it was necessary to assure oneself of one thing, and that was, that private enterprise without subsidy could at the current prices of building material, and of money and labour, provide the 760-square-foot house on undeveloped land on the outskirts of cities, at a cost which would enable it to be let on a commercial basis at rents which the wage-earners could pay and, at that time, even as low as 10*s*. a week. Careful and exhaustive research assured me that it could, and in the outcome it was clear that the conclusion was right.

The plan, then, was to wind up the general subsidy and to confine subsidy to the housing work which there was no hope of getting done without subsidy.

Now, that work was the work of clearing slums and providing alternative accommodation, and private enterprise could not be expected to do it because of two things. The first was cost, and the second was the lack of legal powers.

I have already referred to one thing which makes slum clearance and substitution more expensive than other housing work: it is because typical slums occupy centres of towns where sites are very expensive. Another element of exceptional cost is this. Not always, but often, slum-dwellers are the poorest of the poor. This is another region in which statistics are almost wholly lacking. Nobody could tell you then, and nobody can tell you now, what the average income of a slum-dweller is, in comparison with the average income of other wage-earners. But it is true to say that it is a very poor class, and a class which, in comparison with other classes, is in special need of the benefit of subsidized rents.

As to the matter of legal powers, slum clearance can only be done, of course, economically and efficiently by clearing and re-planning all at once areas of substantial size, and private enterprise is not in the position to do that. It is only the housing authorities which have efficient powers to get hold of the areas and deal with them in units that are big enough. There was in the pigeon-holes at the ministry an unused Act which gave the housing authorities all the powers they needed for slum clearance. As far as legal powers went, it was only necessary to pull this Act out of its pigeon-hole and give it a dusting. To produce in the housing authorities the will to work was, of course, quite another matter. To describe how that was done would take me too far from the field of statistics into the field of politics. One might say, having already wandered so far, why not wander a little farther? But with your permission, in common discretion I will not do so.

Such was the new orientation which was given to policy. It had for its object to clear the field for private enterprise by confining the subsidy to that sphere of needed activity where private enterprise could not be expected to operate: and to concentrate subsidies and public authorities on the work which could not be done without them.

It was hoped thus to secure two benefits. The first was an increase in the production of small houses to be had through private enterprise. The second was to secure the following object, which had never been sought or secured before; that the money found by the tax- and rate-payers for the housing subsidy should earn a direct return in the abolition of slums, and that the subsidized houses provided should be kept for the use of those who, because of the low range of their incomes, needed them.

I should fail to give you any very realistic account of the matter if I did not give some further description of the difficulties encountered in carrying out this plan of campaign. First of all, as regards slum clearance, you would think perhaps that all condemned to live in those loathsome and dreary hovels would be glad to get out of them. But it is not so. Generally speaking, the young and vigorous people were indignant at the conditions under which they had to live, and eager to escape. The old and discouraged, on the other hand, were very often most reluctant to move, and complained bitterly of the change. It is touching how the tendrils of the human heart cling to a home, however poor a form that home may take. It will be understood that it is very difficult to re-house a slum population entirely on the same area. The site is overcrowded, and tenement built, it may not be able to house as many as it housed under the previous bad conditions. Further, if one is to re-house any part of the population on the same area, one must have a decanter—that is, accommodation for them to occupy during the rebuilding of the area. It is extremely difficult and expensive to organize sufficient decanters. The arrangements made for that need are very apt to break down, and it is true, generally speaking, when a slum has been rebuilt, that few of the new occupants are the same as the old. Very often, too, the old area, being central, is used, not for wage-earners' houses, but for some other purpose more appropriate to its high site-value. Generally speaking, therefore, slum clearance means a change of locality for the slum-dwellers.

Though the young and vigorous willingly accept a better house, they join with the old in resisting having to move to any appreciable distance from the scene which has become familiar to them. It is a sad thing to have to cut so many social ties, to move far away from friends and relations, from the familiar shops, public-houses and picture-houses, with all the severance in social ties which it implies. There is indeed a very big force of inertia to be overcome in slum clearance as regards the inhabitants themselves; but more formidable than that is the resistance encountered from those who draw income from the ownership of slum property. There are few—I think there are hardly any—who would be quite consciously and directly indifferent to the knowledge that fellow human beings are being compelled for their benefit to live in misery and degradation, but it is quite astonishing how many by-passes the human mind automatically seeks out in order to escape from that knowledge when they find that they are in danger of it. On the political scene, of course, the most useful expedient for escape is what may perhaps be called the expedient of the hard case. A mind under the influence of the hard case appears to argue as follows :—

"I do not say that it is right for me, who am pretty well off, to draw an income from slum-property, but consider this widow, this orphan or this disabled ex-service man, who has invested the little all in a slum. You could not be so harsh as to expropriate them, and, unfortunate as it may be, if you do not expropriate them, obviously, in common fairness, you cannot expropriate me."

I used to be astonished at times at the high percentage of widows, orphans and disabled ex-service men who had invested their little all, always their little all, in slum property. Of course, there are genuine hard cases of hardship suffered when the local authority comes down and defines a slum area, but no omelette ever got made without some poor little egg being broken in the process and finding itself in a dreadful mess. Try as one may to be fair all round, no great social purpose ever got itself safely achieved without some hardship, so one had to harden one's heart a little to the few sad cases for the sake of a great object. After all, when one has made up one's mind that a certain act is wrong, there is no very good reason why one should consider the personal circumstances of one who does the wrong. If it be wrong to take money for accommodation unfit for human habitation, it is none the less wrong because the one who takes it badly needs what he takes. One may sympathize with the misfortunes attendant upon a mischievous investment without weakening in one's resolution to protect others against the attendant mischief. I know not how it may be with others, but to me there is nothing clearer in the world than that it is wrong and mischievous to offer in the housing market accommodation which is unfit for human occupation. I think, in a comparison which had some success when it was first made, it is just as wrong as it is for a butcher to offer in the market meat that is unfit for human consumption. To hold fast to that is really the first essential of success in attacking slums. Unless one is prepared firmly to adhere to the principle that there must be no compensation for a house unfit for human occupation, one can never succeed. And why should one not adhere to it? A house unfit for human occupation must not be occupied. If it must not be occupied, it has no value. If it has no value, there is nothing to compensate.

One must always, however, be on the alert lest one pour into the cup of human affairs a logic that is too thin and acid. Some concessions are always necessary to those sympathies which must and always will defy logic. This was brought home to me when I was chased one day round a court in Sheffield by an old lady armed with a broom and a strong sense of grievance. It made me realize that there are strains which it is necessary to ease. I found that there were such strains in the case of the small shopkeepers in slums, and in the case of the small owner-occupier. The one claims sympathy for wasted effort; the other because, after all, by living in his slum house he is injuring nobody but himself. He is not nearly so bad from the social point of view as the landlord who makes money out of slums. These strains were eased, and the work was much helped.

Such were some of the difficulties in the way of the slum campaign. I have already referred to the difficulties which there were in the way of that larger campaign for mobilizing all forces available for the supply of small houses, by confining subsidy to the supply of such houses as could not be supplied without it. Those difficulties were by no means small. Once a democracy has become addicted to subsidies for any purpose it is not easy to induce it to relinquish the habit. If you persuade it to make an effort to do without them for its own good, it constantly relapses and finds innumerable ingenious excuses for asking to be allowed to get back to the bottle. Then again, I expect that you have observed, with me, that the difficulties of performing a task usually arise not from those who do not want it performed at all, still less from those who are indifferent whether it is performed or not: they arise almost entirely from those who sincerely wish the task to be performed, but are unable to endure that it should be performed in any way other than that which they advocate. It is the same whether one is driving a nail or looking up a train in Bradshaw with the help of one's family, or inaugurating an effective housing policy with the assistance of the British public. The housing campaign certainly provided a conspicuous example. Some could not bear houses being built without subsidy. Some could not bear them being built by anybody except the Housing Authorities. Some wanted garden cities. Some wanted satellite towns. Some wanted larger and cheaper houses, some larger and dearer, some smaller and dearer, some smaller and cheaper. They may all have been right or, at least, as many of them as could be right all at once: I do not know. But what is certainly true is they were all so intent upon the various means which interested them that they often entirely forgot the end; that often they were, indeed, unable to realize that while they were declaring that no houses could, would, or should, be built except in the way which they advised, the houses were actually getting themselves built.

I have mentioned that even when the slum campaign was well under way and the boom had been started in the building of small houses, there was still a great task to be performed, greater even than either of those. It was the task of dealing with the problem of overcrowding. Overcrowding has been as great an evil in this country as bad quality of buildings. You can make a slum in Buckingham Palace if you overcrowd it. If in an organized State the evil is to be remedied, what is needed for its remedy? The first thing needed is a quantitative standard for accommodation, as well as a qualitative; and the second is means to enforce that standard. Of the means needed, the most necessary is additional accommodation to take the overflow when the new standard is enforced.

It will be understood that the problem of overcrowding was a problem that was far larger, and much less well defined than the problem of the slums. It is much easier to tell whether a house is structurally fit for human habitation than to tell whether it is overcrowded or not. You have more precise ideas to guide you.

I will not now discuss the question where the line ought to be fixed beyond which a house is overcrowded. For good or ill we fixed it for the first time in the Act of 1936. Again, I do not pretend that we fixed it for all time. I will only contend that we fixed it in a sensible position, and gave the country something to work for which was much better than anything there had been before, and which it was possible to attain. It was no good fixing it lower; it would not have been worth while. It was no good fixing it higher; it would have defeated the effort by attempting the impossible.

Again, there was practically no statistical information available about overcrowding. How could there be, when it had never been decided what overcrowding was? But when one considered the samples that were available from various enquiries and returns, it was clear that the problem of overcrowding was very largely a problem of those ill-designed, congested, central areas of working-class accommodation to which I have already referred. You know them well by seeing them out of the windows of the train as it draws into any one of our great industrial cities.

These areas occupy the sites which the wage-earners needs must occupy if they are to be near the factories. I am afraid I do not think it is any good now to talk about shifting our industries to satellite towns. It would involve a capital outlay which is quite beyond the wealth-producing power of our country to provide.

Now, if the wage-earners are to be accommodated without overcrowding on those central areas, two things are necessary. The first is that the areas shall be replanned so as to accommodate as big a population as they can under decent conditions; and the second is that one should be prepared to build up higher in flats so that more families can be accommodated per acre than can be accommodated in two-storey houses. I do not mean flats indefinitely high. Five stories or at the very most six is as much as should be allowed.

When we design an earthly paradise we will not, of course, have flats. We will have nothing but little houses standing in gardens; but if that is to be possible in that earthly paradise there must be no industrial system, such as that with which we have to deal in the actual world in which we live. It is a condition of that actual world of industry as we know it that wage-earners should live in such numbers so near to where they work that if they are to be properly accommodated they must be accommodated in flat buildings.

There is a strong prejudice against such buildings in parts of our land. The prejudice exists mainly in the north; and it is based upon the unfortunate experience which they have had there of bad, dull blocks of industrial dwellings, erected before people had any standards of amenity in the matter. In the south, where flat building began later and after those standards had gained some recognition, of such prejudice there is little or none.

With modern improvements in the design of flats there is no reason, I think, why they should not be perfectly pleasant and healthy places in which to live. Architects have learnt now how to build them so as to provide light, air, quiet, privacy, ready disposal of rubbish, ready access for supplies, and easy communication with the ground. So great has been the advance that now the better-to-do middle-classes and even the best-to-do leisured classes increasingly choose flats to live in, in preference to houses.

The outline of the campaign against overcrowding was, then, as follows. We fixed a standard of overcrowding. We gave the local housing authorities power to take over overcrowded areas in sufficiently large units of area to enable them to replan effectively. We provided a subsidy adequate to enable flats to be built on the expensive central sites, to let at rents within the means of the wage-earners. We imposed an obligation upon the housing authorities to carry out a census of accommodation so as to ascertain what overcrowding there was. We then imposed on them the obligation to provide the accommodation necessary to relieve overcrowding. Finally we drove home a legal nail to clinch the matter by saying that as soon as the additional accommodation necessary to relieve overcrowding was ready, it should be an offence to overcrowd a house, or to permit it to be overcrowded.

I cherished a vision, and it is a vision I still cherish, of a great national reform to be effected on the basis of this scheme. It is a vision that those misbegotten areas of wage-earners' houses that were tossed down higgledy-piggledy in our industrial towns in the last half of the eighteenth and first half of the nineteenth centuries, which are not slums, but which are nevertheless an outrage on the common sense of humanity, will be cleared away under the powers of the Housing Act of 1936 and replaced by well-built and well-planned structures interspersed with open spaces, and decorated with the amenities of life, which will enable a larger population to be accommodated on the same space as before under far better conditions. For rotten and ugly cores to our cities we shall get sound ones. It is, I confess, still a vision. The work has been begun, but it is not proceeding with that speed which ensures success. With such a great reform unless one progresses fairly fast one practically does not progress at all; circumstances are always overtaking one and pulling one back. There must be an effort and a rush, and that we have not got yet from the local authorities. It is a formidable and immense task to take over, replan, and rebuild these great areas of obsolete dwellings. The housing authorities are not yet free from their struggle with the more urgent business of slum clearance, some of them still pay too much attention to making charming new suburbs round their cities. But sooner or later some Government will once more make the necessary effort to direct the energies of the housing authorities in the direction in which they are most required. There must be such a direction, such a concentration by a single will at the centre. Without it, local effort wanders and is lost in the channels of least resistance.

I confess that one thing which stands in the way of success as rapid as we desire with the campaign against overcrowding is a mistake in tactics for which I was responsible. By introducing the Overcrowding Act of 1936 when I did, I allowed the campaign against overcrowding to be launched too soon. It would have been better to wait for two years, so as to allow the campaign against the slums to have been carried a few stages further before the attention of the housing authorities was at all distracted by having to think about overcrowding.

My apology must be that patience is a virtue, no doubt, but one that is extremely difficult. When one thinks one sees what ought to be done, and when the means are within one's control to start to get it done, it is very difficult not to make a start. Nevertheless, it is often more prudent not to undertake too much at once, and I think this was such a case. There will be no harm done if, now that the slum campaign is so far advanced, the effort needed to deal with overcrowding on a large scale is taken in hand and carried forward with vigour; but it needs a fresh impetus.

I know that I am exempt on this occasion from that fire of criticism and comment, so friendly, so lively and, no doubt, so beneficial to the recipient, which commonly awaits the reader of one of our papers. I know that by our polite convention no sound will be heard when I conclude, save the pealing of ceremonial bells, in which the tolling of the passing bell will mingle with the kindly chimes of compliment. Nevertheless, I would not take advantage of even so favourable an occasion to advance any of the grosser fallacies of logic, so I will not contend that the very remarkable increase in the production of small houses which followed the inauguration of this new policy was wholly the consequences of the new policy we inaugurated. No doubt it was in part due to other extraneous circumstances which were totally beyond the control of any policy-monger, but unless you go so far as the Scotch philosopher in denying the reality of causality, you will hardly deny me, if you will glance at the figures given below, some measure of acquiescence in the proposition that this policy was completely successful.

No. of Houses Provided by Private Enterprise without State Assistance

March 31st, 1931	69,746
Sept. 30th, 1931	60,044
March 31st, 1932	68,374
Sept. 30th, 1932	62,456
March 31st, 1933	79,556
Sept. 30th, 1933	87,088
March 31st, 1934	120,781
Sept. 30th, 1934	136,965
March 31st, 1935	149,085

Perhaps these observations on the state of mind of what I have called a policy-monger may be of interest to some future statistician when he is weaving his spells amongst the figures of housing statistics. What shall I say about the movement which I have described? On behalf of the dozens, nay hundreds, of hard workers who took part in it with me and have continued it since, I will say this. Our opportunity to get something done about housing was undoubtedly good, and we made good use of it. We controlled and directed the forces available for the improvement of housing conditions so as to make sure that they were exerted to the greatest possible extent in the right direction, and in the right direction only, and that they were not wasted in unnecessary effort. I mean, that we controlled both the money available for subsidies, and the energies of the housing authorities, and directed them to the removal, first of slums, and next of overcrowding. We cleared away also the obstruction of ill-designed subsidies and legislation which had cumbered the housing field since the war, and enabled the available forces of commercial productivity to make the best of themselves in the interest of the community. And what were the results? They were, an acceleration of slum clearance, that has already all but ended the evil in smaller towns, and promises an end to it in the larger towns within a foreseeable future; and the plan of campaign against the evil of overcrowding, with which a beginning has been made, and which, although it has not yet been fulfilled, can be carried to a successful conclusion as soon as the Government and the housing authorities can find time and energy for the purpose.

Let me show what was achieved by the slum campaign, in about 5 full years of work—for in the first year we were still working up.

[From the Official Return.]

TABLE I

Housing Acts, 1930 *and* 1936

Clearance Areas and Improvement Areas

Resolutions declaring Areas to be Clearance Areas or Improvement Areas

	Up to September 30th, 1937
1. Number of local authorities who have passed resolutions declaring areas to be clearance areas or improvement areas	859
2. Number of areas declared	16,294
3. Number of houses in clearance areas and improvement areas to be demolished as a result of resolutions passed	232,211
4. Number of persons in clearance areas and improvement areas to be displaced by demolition of houses as a result of resolutions passed	965,711
5. Number of persons in improvement areas to be displaced in order to abate overcrowding as a result of resolutions passed	4,944

TABLE II

Housing Acts, 1930 *and* 1936

Clearance Areas

Statement as to Clearance Orders and Compulsory Purchase Orders made by Local Authorities under Resolutions declaring Areas to be Clearance Areas, with certain particulars as to houses in clearance areas purchased by agreement

	Up to September 30th, 1937
1. Number of local authorities—	
(*a*) Submitting orders to the Minister	790
(*b*) Whose orders were confirmed by the Minister ...	742
2. Number of orders—	
(*a*) Submitted to the Minister	14,575
(*b*) Confirmed by the Minister	11,747
3. Number of houses to be demolished specified in the schedules to the orders—	
(*a*) Submitted to the Minister	204,204
(*b*) Confirmed by the Minister	166,688
4. Number of persons to be displaced from houses specified in the schedules to the orders confirmed by the Minister	720,442

TABLE III

Housing Acts, 1930 *and* 1936

Slum Clearance

Statement as to the Number of Dwelling-houses Demolished or closed under the Acts, the Number of Persons Displaced, and the Number of Dwelling-houses made Fit

	Up to September 30th, 1937
CLEARANCE AREAS :—	
1. Houses demolished	97,457
2. Persons displaced	424,682
IMPROVEMENT AREAS :—	
3. Houses demolished	866
4. Persons displaced—	
(*a*) By demolition of houses	3,384
(*b*) To abate overcrowding	3,207
5. Houses made fit	2,005
INDIVIDUAL UNFIT HOUSES :—	
6. Houses demolished as a result of—	
(*a*) Formal procedure under the Acts	45,830
(*b*) Informal notices preliminary to formal procedure	7,691
7. Parts of buildings closed	8,905
8. Persons displaced (from houses demolished as a result of formal procedure under the Act or in part closed)	190,774
9. Houses in respect of which undertakings not to use for human habitation were given	11,470
10. Houses made fit as the result of—	
(*a*) Formal procedure under the Acts	156,611
(*b*) Informal notices preliminary to formal procedure	437,648
TOTAL :—	
11. Houses demolished, closed or not to be used for human habitation	172,219
12. Persons displaced as a result of formal procedure under the Acts	622,047
13. Houses made fit as a result of formal procedure under the Acts	158,616

TABLE IV

Housing Acts, 1930 *and* 1936

Rehousing Accommodation

Statement as to (a) *the Number of Houses Approved by the Minister and* (b) *the Number of Houses Completed for the Purpose of Rehousing Persons Displaced from Clearance and Improvement Areas and from Individual Unfit Houses not in Clearance or Improvement Areas*

	Up to September 30th, 1937
1. Number of local authorities whose proposals for rehousing persons displaced under the Acts of 1930 and 1936 have been approved	1,101
2. Number of houses in proposals approved	237,296
3. Number of local authorities who have completed houses for rehousing persons displaced under the Acts of 1930 and 1936	980
4. Number of houses completed	163,274
5. Number of persons for whom the houses in Item 4 provide accommodation in accordance with Section 136 (*b*) of the Act of 1936	764,669

PROCEEDINGS OF THE MEETING

PROFESSOR GREENWOOD: Our newest Honorary Vice-President has not only given us a charming address, but he has added to the honorific appellations which he, in common with other Honorary Vice-Presidents, will be entitled to assume. It is some years since another Honorary Vice-President whom, in humbler days, we knew as Josiah Stamp, decided that they were entitled to be described as "extinct volcanoes." Now they may be known as "ceremonial bells," a very large genus, which includes as an important species the dinner bell.

But statistically speaking, few of our Honorary Vice-Presidents will need either of these appellations. We are honoured by the existence of no less than eight Honorary Vice-Presidents, five of whom are Lords Temporal in this present Parliament assembled; a sixth wears, or at least is entitled to wear, golden spurs. There remain only two, the Mendelian proportion of Pure Recessives, who will rejoice in the appellation. Mr. Udny Yule and I will cherish it, and in chiming I must be partly cheerful and partly funereal because we are not only loosing a charming President, but I am afraid we are loosing a statistician in the making. In his inaugural address our President was witty and wise, but he wholly eschewed statistical tabulations. In his valedictory address he is again witty and wise, but several tables—formidable tables, tables the interpretation of which might even, at grimmer moments, give rise to discussion—both cheer the eyes and gladden the hearts of professional statisticians. But our retiring President has seen the danger, and perceived that he had reached the summit of a steep declivity. If that is too unliterary a metaphor for this Society, I may remind all those over fifty, and inform those under fifty, of the way in which Neptune in the first book of the *Æneid* received an effort to destroy the statistical regularity of Mediterranean meteorological data. Being on the point of drastically criticizing the data, he confined himself to a mere "*quos ego*." Our President has allowed the tables to speak for themselves. Wisely, because directly one departs from the invariable practice of our ancestors in this Society, who always allowed tables to speak for themselves, and passes from tabulation to calculation of arithmetic means, it is only a step from that to the study of variation, and that is cheek by jowl with co-variation, fiducial limits, confidence belts and so on. But

> ". . . I avert my face, nor follow him
> Into that sad, obscure, sequestered state
> Where God unmakes but to remake the soul
> He else made first in vain, which must not be."

In other words, one averts the eyes from the process of transforming the statesman into the statistician. That might have been our aim.

I confess that I should have liked in another year to hear our President on confidence belts and fiducial limits, but it would have been a loss to statecraft, and I may only hope and believe that our President, or rather our Honorary Vice-President, will take back into the greater world a kindly recollection of us.

I see him in the mind's eye at some great assembly, in the house of Lords, flanked by two other Vice-Presidents of this Society. It is 7.30 in the evening, an hour at which professional statisticians frequently adjourn: the House is crowded to suffocation because Lord Kennet is up. He will have many memories, memories of what he said about democracy and the newspapers in his inaugural address, memories of what the late Earl of Oxford and Asquith said about the level of speaking in the House of Lords, memories above all, of the golden ass of a force of 200 decibels. I am quite sure that he will mention none of these, that he will begin by pointing out that under the ædileship of Hilton Young 163,274 houses were completed and 764,689 persons were, statistically speaking, accommodated. He will point out that these results differ significantly, by far more than the standard error of sampling, from those obtained by subsequent ædiles, and he will receive—assuming of course that no test match was played on the same day—a warm meed of applause in the first leader of the *Times* on the following day. That apotheosis will surely in part be due to the training he has received here.

I beg to move that our heartiest vote of thanks be accorded to our retiring President for his address.

LORD MESTON: I have very great pleasure in associating myself with Professor Greenwood in what was described as the ringing of our ceremonial bells to-night. He suggested that there might be an element of discord, or at least of sadness, in the passing bells which would participate in the chime: I can myself most cordially say that there will be no element of discord in the very brief chime you are going to hear from my particular belfry.

Lord Kennet recalled with a tinge almost of regret that he on this occasion, and this occasion only, is immune from the vivacious criticism and expert comment to which the speaker in this room is so regularly subjected. I cannot help thinking that even if that convention were not established, it would be one of the last things that we should attempt to do this afternoon, to interject either comment or criticism, partly because we could not be guilty of the *lèse-majesté* of criticizing our President, but partly because there is so little to criticize and so much to agree with in his delightful paper. It seemed to me exactly the sort of paper which a learned Society like ours should experience now and again. A learned Society is never conscious of its own demerits: and it is extraordinarily good if from time to time a worker in some field of the world's vast activities can come and tell us where our labours meet with the needs of practical business, practical science, practical administration, and where they fail to meet those needs, and at the same time could be made to meet them. In many instances the lessons we have had taught to us to-night are lessons which we as a Society ought to take to heart, and I imagine there will be a rush of the Fellows of the Royal Statistical Society after this evening, to test by curve and calculus the justice of Lord Kennet's assumption of 10s. rental and 750 square feet superficial area. Probably some of our enthusiasts will investigate the domestic details with even closer care. I can imagine an interesting excursus on, let us say, the ratio of success in driving picture nails as between *A*, the driver, male or female, who works on the principle of self-determination, and *B*, the male or female who is inspired by the wife or husband at the foot of the ladder who directs operations and protests against the language which is used when the hammer fails to hit the nail and hits something else.

We have to congratulate ourselves upon an essay of real delight and interest dealing with problems which touch the deepest springs of human nature. Too rarely do we have an opportunity of listening to one who, having served as a Minister of the Crown and having played a great part in this new movement of social progress—the housing of the people—takes us so fully into his confidence and tells us what his policy was and what were its results. Our speaker to-night is one who tackled that particular job at its most difficult time, when ignorance and prejudice were running high and vested interests running strong. He is one who still preserves a clear logical humane idea of what the great needs of our people and of our country demand.

I have infinite pleasure in seconding the vote of thanks which Professor Greenwood has just moved.

The Vote of Thanks was put to the meeting and carried unanimously.

LORD KENNET: I thank you greatly for your too kind vote. I thank Professor Greenwood and Lord Meston for the kind terms in which they have proposed and seconded that vote. It is not true that I have even partially assumed the characteristics of a statistician. I am very, very sorry, but I am afraid probably it was too late, or else the soil was too infertile, and I think if you will look at the evidence which Professor Greenwood has produced in order to suggest to you that I have acquired so celebrated a status as that of a statistician, you will find it is very slight. What does it amount to? Only four tables, all of them borrowed directly from an official publication.

I ventured to say a word when I was speaking before about how profoundly interesting this experience has been to me, an opportunity from which I have benefited not only by direct instruction, but also by social intercourse with so many brilliant and distinguished minds, and let me assure you that to my dying day, if there is one thing which I shall be more proud of than anything else, it will be that I have actually on two occasions read papers to the Royal Statistical Society without being thrown into the street.

[The Proceedings then terminated.]

As a result of the ballot taken during the meeting, the ten candidates named below were elected Fellows of the Society :—

Eric James Broster.
Herman Otto Hartley.
Pao-Lu Hsu.
Robert William Brierley Jackson, Ph.D.
Charles Edward Lane-Poole.
Hugh Cecil Meharg, B.Com.Sc., A.C.A.
Gibson Pattison.
Hubert C. Plaut, Ph.D.
John Arnold Reece, B.Sc.(Econ.).
Leslie Ernest Warner.

MISCELLANEA

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An International Convention on Statistics of Wages and Hours of Work

By J. W. Nixon, B.Sc.

At the twenty-fourth session of the International Labour Conference held at Geneva in June 1938, a draft International Convention was adopted concerning the statistics of wages and hours of work in mining and manufacturing industries and in agriculture. Of the 63 International Conventions on labour questions adopted by the International Labour Organization since 1919, this is the first to deal with statistics. Its object is primarily to standardize and improve the national statistics on the above subjects; a short account of its provisions may therefore be of interest to readers of this *Journal.*

In 1928 an International Convention relating to economic statistics was adopted at a conference called by the League of Nations, and has been ratified by a large number of countries. This Convention covered a wide range of subjects, and its provisions were somewhat more flexible than those of the recent Convention on wages and hours of work. In particular, it contained no obligations on a ratifying country to state to what extent it had given effect to its provisions. The present Convention is of a more binding character, the nature and scope of the statistics to be compiled are set out in detail and, in accordance with the constitution of the International Labour Organization, each country, on ratification, undertakes to furnish an annual report in a prescribed form on the measures it has taken to give effect to its provisions. These reports are submitted to a special committee of experts and also to the annual sessions of the International Labour Conference, and machinery is provided in the Constitution for dealing with any complaints or representations that the effective observance of the Convention is not being secured. The Convention of Statistics on Wages and Hours may therefore be described not only as the first Convention on labour statistics, but also as the first International Statistical Convention the application of whose provisions is subject to international supervision.

Before the subject was submitted to the International Labour Conference, a considerable amount of preparatory work was undertaken. First a small Committee of Statistical Experts was consulted as to the scope of, and the points which might be covered by, such a Convention. These were then submitted to a Technical Conference of Official Labour Statisticians, to which all Members of the Organization were invited. This Conference, to which detailed reports analysing the existing statistics of the different countries were submitted, prepared a series of draft articles, and these were in turn submitted to the annual International Labour Conference, at which both Governments, employers and workers are represented. This Conference prepared the final text which was adopted by 125 votes for, and none against.

The Convention consists of 31 articles grouped into six Parts, viz.:

Part I. General Provisions.

Part II. Statistics of average earnings and of hours actually worked in mining and manufacturing industries.

Part III. Statistics of time rates and of normal hours of work in mining and manufacturing industries.

Part IV. Statistics of wages and hours of work in agriculture.

Part V. Miscellaneous Provisions.

Part VI. Final Provisions.

The parts which are of special interest to statisticians are Parts II, III and IV; the other parts consist chiefly of "standard articles" which appear in all international labour conventions, though some of the articles in these parts are of importance, and will be referred to later.

As regards Parts II, III and IV, the first point to be noticed is that the statistics to be compiled in pursuance of this Convention are limited to the *principal mining and manufacturing industries* (including in this latter term building and construction) and to *agriculture*, and also to *wage-earners*. Other branches of economic activity (*e.g.*, commerce and services) and other categories of workers (*e.g.*, salaried employees and officials) are not covered. The reason for these limitations is that statistics in these branches and for these categories were not considered sufficiently ripe, or in some cases appropriate, for inclusion in the scope of an International Convention. An exhaustive analysis of the statistics at present compiled by the different countries which was submitted to both the Conferences mentioned above showed that, owing to the special character of these branches (*e.g.*, the absence in some cases of collective agreements fixing wages), their heterogeneous character and the undeveloped state of the statistics relating to them in many countries, it would have been unwise to have attempted in this first Convention to have included provisions relating to these other branches. Even for agriculture it might be thought that similar considerations would justify its exclusion, but it was felt that an International Convention on statistics of wages and hours of work would be incomplete without some reference to the world's largest industry. As will be seen later, the obligations imposed by the Convention in the case of agriculture are much more general in character than those in the case of mining and manufacturing.

The second point to be noticed is that of the two parts of the Convention (Parts II and III) devoted to the mining and manufacturing industries; one part relates to *average earnings and hours actually worked,* and the other to *time rates of wages and normal hours of work.* These are treated in separate parts for two reasons: one concerns the method of ratification of the Convention, and will be referred to later, the other is that, though these two classes of statistics have certain features in common (as shown by the fact that certain articles and paragraphs in Part II are identical with those of Part III), yet the differences in their scope and use, their methods of compilation, the sources utilized, etc., render necessary a clear distinction between the provisions of the Convention relating to earnings and actual hours on the one hand and those relating to time rates and normal hours on the other.

Both parts provide that the statistics are to be compiled at least once a year—for " each of the principal mining and manufacturing industries " in the case of average earnings and actual hours, and " for the main occupations in the most important of these industries " in the case of time rates and normal hours, etc.—and for more detailed statistics at least every three years. In the case of *earnings and actual hours,* these more detailed statistics consist of separate figures for males and females and for adults and juveniles, and in the case of *time rates and normal hours,* of separate figures " for the principal occupations in a wide and representative selection of the different industries," together with information (where the sources contain such particulars) as to payments for holidays, family allowances, overtime rates, etc.

Each of these two parts of the Convention also provides for the compilation of index numbers showing the general movement of earnings, and the general movement of rates of wages. In the case of rates, it is provided that information shall be given which will enable index numbers of hourly rates to be converted into index numbers of weekly rates, or vice versa, and also that other information, such as changes in piece-work rates of wages, should be used for the compilation of the index numbers. No other reference is made to piece-work rates of wages in this part of the Convention, since they do not lend themselves to statistical tabulation. Any index number purporting to show changes in the movement of wage rates as a whole or in an industry such as the textile industry, would be unsatisfactory if it were based on time rates only, and as wages of piece-workers are often regulated by percentage additions to, or deductions from, a standard list, it is generally possible to include changes in wages of such categories of workers in the index numbers.

As regards the time unit in which the wage statistics are expressed, the Convention provides that the statistics of wages shall relate to earnings and rates per hour, or to earnings and rates per day, week or other customary period; in the latter case, it is provided that the statistics of hours of work shall relate to the same periods as those of wages.

The Convention does not give a list or enumeration of the principal mining and manufacturing industries (in the case of earnings), nor of the principal occupations (in the case of time rates). Such an enumeration would necessarily differ from country to country, and it was felt that it would be better to leave the determination of what are the principal industries and occupations to the competent authority. Since each ratifying country must furnish an annual report on the measures it has taken to apply the provisions of the Convention, and must also compile index numbers showing the *general* movement of wages, it will be difficult for a country to comply with the terms of the Convention if any of its principal industries or occupations are omitted.

The part of the Convention devoted to agriculture (Part IV) contains provisions which are much less rigorous than those in the case of mining and manufactures, as already stated. It provides for the compilation of statistics of wages at intervals not exceeding two years, and these statistics may relate either to rates of wages or to average earnings. In view of the importance of allowances in kind, it is provided that indications shall be given as to the nature of these allowances, and, if possible, an estimate of their money value. Provision is also made that these statistics shall be supplemented by indications as to the hours of work. In some countries the statistics refer to common categories of workers, without indicating the particular work they perform; where information is compiled, however, for different categories, it is provided that the statistics shall be supplemented by indications as to these categories.

As pointed out above, time rates and normal hours, and average earnings and actual hours are dealt with (in the case of mining and manufactures) in two separate parts of the Convention. During the discussions on this Convention, especially at the Technical Conference of Labour Statisticians, the question of the relative value and importance of these two classes of statistics was raised. Some countries compile comprehensive information on time rates, while information on average earnings is less comprehensive or less frequent. Other countries are in the reverse position : information on earnings is comprehensive and frequently compiled, whilst that on rates is meagre and irregular. It is not possible in this short note to go into the reasons for the preference given to one or the other in the various countries.

It might be mentioned, however, that the practice of regulating wages by collective agreement is more developed in some countries than in others, and that the extent to which the rates laid down in these agreements (often described as minimum rates) are exceeded in practice may vary. The term " time-rate " is frequently qualified by some such word as "standard," " typical," " prevailing," " recognized," " minimum," and the extent to which the rates described by these terms represent those actually paid may vary considerably. The representatives of some countries even asserted that the information on rates available in their country in such sources as collective agreements, in minimum wage decisions, etc., was of little value as reflecting actual conditions of employment, and that in such cases, statistics of actual earnings would give a more satisfactory picture. Earnings statistics are also to be preferred in those countries (some of them important industrial countries) where collective bargaining and other methods of fixing rates of wages for groups of workers are not fully developed. Provision was therefore made for both these classes of statistics, but in view of the fact that some countries give a preference in their statistics to one class and some countries to the other, and ratification would be delayed if countries were to be obliged to compile both classes of statistics, a special article was introduced into Part I (General Provisions), by which countries may exclude from their acceptance of the Convention, either the part on average earnings and actual hours (Part II) or the part on rates and normal hours (Part III), but not both, and may also exclude the part dealing with agriculture (Part IV).

The Conference considered, however, that this faculty of excluding one or more parts should be accompanied by some arrangements intended to encourage the ultimate application of the parts excluded, and an article therefore provides that in the annual reports upon the application of the Convention, to be made by each ratifying country, the extent to which progress has been made with a view to progressive compliance with the provisions of any parts excluded, shall be indicated.

Other general articles of importance are the one which provides that each ratifying country shall make enquiries relating either to all or to a representative part of the wage-earners in the industries covered, in order to obtain the information as to wages and hours of work, and shall compile and publish the statistics at regular intervals, and the one which provides that nothing in the Convention shall be interpreted as requiring the use of compulsory powers. It was generally agreed that statistics of this kind should be based as far as possible on the voluntary co-operation with the Governments of the parties concerned (employers' and workers' organizations). Some countries possess compulsory powers (which are, however, not always exercised) for the collection of statistics, and in many countries legislation provides for the compulsory notification of collective agreements. Another article (similar to one in the International Convention relating to Economic Statistics) provides that the Convention is not to be regarded as imposing any obligation to publish statistics which would disclose information relating to any individual firm. Finally, an article provides for the measures to be taken for the improvement and amplification of the statistics compiled in pursuance of this Convention. The Convention will come into force twelve months after the date of ratification by two countries.

A Convention of this technical nature could not have been drafted without the collaboration of the official statisticians of different countries, and it is a pleasure to acknowledge here the valuable assistance of Mr. Ramsbottom, Director of Statistics of the Ministry of Labour and Silver Medallist of the Royal Statistical Society, at the preliminary Committee of Statistical Experts, at the Technical Conference of Official Labour Statisticians, and as Rapporteur on this subject at the International Labour Conference.

STATE EXPENDITURE ON AGRICULTURE IN GREAT BRITAIN IN 1938–39.

By R. J. THOMPSON, C.B.

IN view of the various estimates of the aggregate expenditure on agriculture in Great Britain which are made from time to time, it may be of interest to extract from the Parliamentary Estimates particulars of the outlay proposed for the current year (1938–39). This outlay is subject to some expansion as a result of Supplementary Estimates which may be presented to Parliament later in the year.

The commodities specifically aided by grants from the Exchequer are sugar beet, barley and oats, cattle and milk. Of these the provision for sugar beet at £2,550,000 is much less than it was some years ago, steps having been taken in 1935–36 to limit the liability under this head. In a sense the outlay is partly met by the special excise duty on sugar beet (lower than the preferential duties on Empire produce), which is estimated to yield £1,991,000. Growers of barley and oats enjoy this year, for the first time, a form of price insurance by which a subsidy is payable when the average price falls below a prescribed figure, and a sum of £203,000 is provisionally included, although the actual amount payable is somewhat uncertain.

A larger item is the cattle subsidy, which is intended to compensate for the prevailing low prices of cattle and at the same time encourage the production of good quality animals; this is estimated to cost £4,575,000. Milk producers bear the cost of the Milk Marketing Board, but special assistance is given to the Board under three heads—namely, payments in respect of milk used for manufacturing purposes, £112,000; encouragement of the production of milk of higher quality, £23,000; and a contribution towards raising demand, which includes milk purchased for schools, £303,000. These milk figures are, however, only in respect of the first half of the year, and there will be a Supplementary Estimate.

Another form of subsidy, somewhat different in type, is the contribution towards the cost of lime and basic slag with the object of encouraging farmers to improve the fertility of their land; the provision for this amounts to £1,282,000. These five subsidies for special purposes come to just over £9,000,000.

In addition to these direct forms of expenditure, there are the substantial sums included in the Votes of the Ministry of Agriculture and the Department of Agriculture for Scotland. An immense variety of activity devoted to the development and promotion of agriculture is represented here, including agricultural education

(£461,000), agricultural research (£507,000), prevention of diseases of animals (£825,000), improvement of live stock (£107,000), land drainage (£372,000), together with numerous other items, including the general cost of administration. The total outlay in these Votes which may be treated as incurred for the benefit of agriculture comes to about £3,000,000 for the Ministry of Agriculture, and £500,000 for the Scottish Department. A portion of these sums is drawn from the Development Fund, but as this Fund originates in the Exchequer, the total is unaffected. There is also certain expenditure amounting probably to over £200,000 on buildings, printing, stationery, etc., borne on the Votes of other Departments. Another item is the cost of the Agricultural Research Council, amounting to £61,000, which is borne on the Education Vote.

A grant of an entirely different character is the contribution in respect of the derating of agricultural land in England and Wales. An allowance for this is included in the Block Grants to Local Authorities, but the amount in respect of agricultural rates is not specifically shown. In 1929–30, when agricultural land was finally relieved from the liability to assessment for local rates, the value of the relief was over £17,000,000.

The items mentioned above are covered by Parliamentary Votes, but in addition there is the wheat subsidy, which does not come from the Exchequer, but from a levy on imported wheat and flour administered by the Wheat Commission. This is equivalent to an import duty, and the result is the same as if the money passed through the Exchequer. In 1936–37 the payments under this head came to £1,339,000, and are estimated to amount to just over £2,000,000 in 1937–38. The total fluctuates from year to year according to the price of wheat. In 1935–36 it amounted to £5,230,000.

Bringing all these items together, including the estimated derating contribution, we get a total of nearly £32,000,000, a sum which may be taken as an approximate indication of the current level of State expenditure on agriculture in Great Britain.

REPORT OF THE COUNCIL

For the FINANCIAL YEAR *ended December* 31*st*, 1937, *and for the* SESSIONAL YEAR *ending June* 21*st*, 1938, *presented at the* ONE HUNDRED AND FOURTH ANNUAL GENERAL MEETING *of the* ROYAL STATISTICAL SOCIETY, *held in the Hall of the Royal Society of Arts, John Street, Adelphi, W.C.*2, *on June* 21*st*, 1938.

THE Council have the honour to submit their One Hundred and Fourth Annual Report.

The roll of Fellows on December 31st, 1937, as compared with the average of the previous ten years, was as follows :—

Particulars.	1937.	Average of the previous Ten Years.
Number of Fellows at end of previous year ...	1049	1055
Number lost by death, withdrawal, or default ...	45	59
Fellows elected or restored to the list	59	58
Number of Fellows on December 31st	1063	1054

In addition, there were 14 Honorary Fellows.

The Council regret to report that during the sessional year ended June 21st, 1938, the Society lost by death the undermentioned eleven Fellows and two Honorary Fellows :—

Fellows

	Date of Election.
Bayfield, Arthur	1877
Bolling, Cunliffe Lawrance	1929
*p*Daniels, Professor George William	1930
*Elliott, William	1885
Gosset, William Sealy	1933
Lee, Herbert Victor, O.B.E.	1934
Philip, George	1918
Russell, Arthur B., F.C.A.	1886
*Vaizey, Ker G. R.	1903
Whitehead, James, K.C., J.P.	1931
*d*Williams, Frederick A., A.I.A., F.A.S.	1904

Honorary Fellows

Delatour, Albert	1918
Georgievsky, Paul I.	1914

* Life Fellow. *d* Donor to the Library. *p* Read a Paper or Papers.

The list of losses by death includes the names of two eminent Fellows, both of whom died at a comparatively early age in the fullness of active work. Mr. W. S. Gosset's original work in mathematical statistics, published under the name of "Student," won recognition all over the world, and all who came in contact with him appreciated his courtesy and charm no less than they admired his scientific achievements. He was a highly valued member of the Industrial and Agricultural Research Section and served on its Committee up to the time of his death. He several times took part in their proceedings and opened a discussion on Co-operation in Large-Scale Experiments at the meeting of the Section in March 1936.

The death of Professor Daniels, who held the Jevons Chair of Political Economy in the University of Manchester, is also especially regretted as a loss to the Society, to economic science, and, most of all, to the University to which he was devoted and where he was held in the highest esteem and affection. Professor Daniels read a paper on "The Post-War Depression in the Lancashire Cotton Industry" (written in collaboration with Mr. Jewkes) before the Society in 1928.

Obituary notices of Mr. Gosset and of Professor Daniels were published in Part I of the *Journal*, 1938.

Mr. Bayfield, Mr. Elliott, and Mr. A. B. Russell had been Fellows for more than fifty years. The deaths of the two former took place before the current session, but the Society only received the intimations this year.

Two of the senior Honorary Fellows on the roll passed away in March of this year. M. Albert Delatour, who died on March 5th, in his eightieth year, was elected in 1918. He was at that time a member of the Conseil Supérieur de Statistique de la France and a Past President of the Société de Statistique de Paris. He was appointed President of the International Statistical Institute in 1923 and an Honorary Vice-President on his retirement from the Presidency, after twelve years of active and devoted work in the service of statistics and, especially, of international co-operation in their use and development.

Professor Georgievsky, who died in his eighty-second year, was the foremost economic statistician in Tsarist Russia. He was made Professor of Political Economy and Statistics in 1888, and Emeritus Professor twenty years later. In 1911 he became Director of the Central Statistical Committee and in 1914, the year of his election to this Society, was appointed President of the Statistical Council of the Russian Empire. After the Revolution he left Russia and from 1922 onwards held the Chair of Statistics in the Russian Faculty at the University of Prague.

Obituary notices of both these eminent statisticians appeared in Part III of the *Journal*, 1938.

During the session 1937–38, the following 68 candidates have been elected Fellows of the Society :—

Berry, William Hubert, A.I.M.T.A.
Bingham, James Herbert, M.I.Mech.E.
Broster, Eric James.
Cairncross, Alexander Kirkland.
Carrington, Arthur John.
Carruthers, A. Stanley.
Dickinson, H. D.
Dugdale, Lilian Madge, B.Sc.
Durve, Shridharrao Yashvantrao, B.A.
Feavearyear, Albert Edgar, D.Sc.
Gardner, Archibald, M.B., Ch.B.
Goodall, George, M.A.
Gould, Charles Alfred, M.C., B.Sc.
Hall, Noel Frederick.
*Harding, Archibald Seymour.
Hartley, Herman Otto.
Hey, George Brian.
Hitchcock, Eldred Frederick, C.B.E.
Horn, Alfred John.
Howlett, Jack.
Hsu, Pao-Lu.
Jackson, Robert William Brierley.
Kapadia, M. G., B.A.
Kemsley, William Frederick Fenn.
Kuczynski, Jürgen P.
Lane Poole, Charles Edward.
Leybourne, Grace Gwendoline, M.A., B.Sc., Ph.D.
Maung, Thet.
Meharg, Hugh Cecil.
Nevard, Thomas William.
Newton, Mary Posnett.
Pattison, Gibson.
Percival, David Athelstane.
Plaut, Hubert C., Ph.D.
Poole, Charles Ronald.
Pritchard, David Dylan, M.A.
Reece, John Arnold, B.Sc.(Econ.).
Rothwell, Lionel Alan, A.S.A.A.
Roychowdhury, Khirod Behari, B.A., B.L.
Samuel, Josiah, M.Com.
Scott, Thomas Buttress.
Shafei, Abdul-Moneim Nasser, B.Sc., Ph.D.
Shrimpton, Ernest Arthur George.
Silcock, Thomas Henry, M.A., D.Phil.
Singh, Arjan.
Smith, Sydney Charles, F.I.M.T.A.
Stern, Ernst.
Subba Rao, M. V., B.A.
Taylor, Stuart Mathias.
Tobilcock, Dick Haydon.
Turner, Alix Breillat, B.A.
Turner, Alice Willard, M.A., Ph.D.
*Vaidyanathan, M., M.A.
Walker, Harold.
Warner, Leslie Ernest.
Watts, Edmund Hannay.
Widdowson, Norman.
Wilson, William A., M.A., B.S.

Corporate Representatives.

Drury, Thomas Lachlan,	*representing* The General Post Office (Headquarters Library).
Fisher, Edwin,	*representing* Barclay's Bank, Limited.
Josephs, Henry John, Scrivener, Walter Henry,	*representing* The Post Office Engineering Department.
Laky, Professor D. de,	*representing* The Statistical Seminar of the Jozsef Nador Müegyetem, Budapest.
Nicholson, Edward Max,	*representing* Political and Economic Planning.
Silvey, Robert John Everett,	*representing* The British Broadcasting Corporation (in place of Major C. F. Atkinson).
Smith, Alan Russell,	*representing* Imperial Chemical Industries.
Smith, Hugh Fairfield,	*representing* The Rubber Research Institute of Malaya.
Wedmore, E. B., M.I.E.E., F.Inst.P.,	*representing* The British Electrical and Allied Industries Research Association.

* Re-election.

The number of Fellows is now 1,053, compared with 1,039 in June 1937.

The ordinary Meetings have been held in each month of the Session, and the papers read and discussed before the Society were as follows:—

1937.	
I.—November 16th ...	Jones, R. Huws, M.A., B.Sc.(Econ.), Physical Indices and Clinical Assessments of the Nutrition of School Children.
II.—December 21st ...	Isserlis, L., M.A., D.Sc. Tramp Shipping, Cargoes and Freights.
1938.	
III.—January 18th ...	Houghton, C. T. A New Index Number of Agricultural Prices.
IV.—February 15th ...	Rae, George, D.Sc. The Statistics of the Rubber Industry.
V.—March 15th ...	Glenday, Roy G., M.C., M.A. Long Period Economic Trends.
VI.—April 26th	Discussion on "Is the Trade Cycle a Myth?", opened by E. C. Snow, C.B.E., M.A., D.Sc.
VII.—May 17th	Stocks, Percy, M.A., M.D. The Effects of Occupation and of its Accompanying Environment on Mortality.
VIII.—June 21st	Kennet of the Dene, The Rt. Hon. Lord, P.C., G.B.E., D.S.O. D.S.C. Valedictory Address: Some Footnotes to Housing Figures.

At the meetings of the Industrial and Agricultural Research Section the following papers were read and discussed:—

1937.	
I.—November 18th ...	Discussion on "Crop Estimation and its Relation to Agricultural Meteorology," opened by J. O. Irwin, Sc.D., D.Sc.
1938.	
II.—March 24th ...	Simpson, T. Wake. Experimental Method and Human Nutrition.
III.—April 29th	Daniels, H. E. Some Problems of Statistical Interest in Wool Research.
IV.—May 26th	Hoblyn, T. N. A Study of the Variation in Keeping Quality of Apples in Store.

The Honorary Secretary of the Committee of the Section, Professor Egon Pearson, reports as follows:—

The year's programme again illustrates the wide variety of useful purposes to which the tools of mathematical statistics may be turned by the trained statistician when he has once gained recognition in a research institute or laboratory. The detailed illustrations of the application of methods in one field of experimental work have often proved stimulating to those working on analogous problems in a different field. The Committee hope to hold one evening meeting next winter at a Works in London. Viewing of manufacturing processes would be followed by an organised discussion of the statistical aspects involved. The Committee also hope to arrange a meeting at Leeds in co-operation with the Director of the Wool Industries Research Association.

During the session 1937–38, the Study Group, under the Chairmanship of Mr. R. F. George, held nine meetings, and the papers read and discussed were as follows :—

1937.	
October 13th ...	George, R. F. Food Supplies of the United Kingdom in the 19th Century.
November 9th ...	Thomas, Brinley, Ph.D. Use of the Census for Measuring Population Movements.
December 14th ...	Cochran, W. G. Human Bias in Sampling.
1938.	
January 11th ...	Glass, D. V. Fertility and Status in London.
February 10th ...	Flux, Sir Alfred, C.B. The Measurement of Saving and Investment.
March 8th	Marschak, J. The Work of the Oxford Institute of Statistics.
April 12th	Selwyn, J. B. The Cost of Raising Capital.
May 10th	Stone, J. R. N. and W. M. The Marginal Propensity to Consume and the Multiplier.
June 28th ...	Quigley, Hugh. New Industrial Developments in 1937.

In the year ended May 31st, 1938, 1,216 works were added to the Library, compared with 1,240 the year before. These figures exclude periodicals regularly received and a number of Parliamentary Papers. During the same period 1,685 volumes were borrowed by 774 Fellows, against 1,231 by 510 Fellows the year before.

Mr. J. A. P. Mackenzie, who had been the Librarian for forty-five years and a member of the staff for fifty-six years, retired from the Society's service at the end of 1937, on pension. The Council greatly regret parting with him after so long a term of zealous service.

In making new arrangements with respect to the staff, the Council have entered into an insurance scheme for the provision of a contributory superannuation fund for the younger members, on the lines of the Federated Superannuation Scheme of the Universities.

The Council have awarded a Guy Medal in Silver to Mr. Edmund Cecil Ramsbottom, O.B.E., for his paper "Rates of Wages in the United Kingdom, 1921–34," read before the Society in June 1935, and published in Part IV of the *Journal* for that year.

They have also awarded a Guy Medal in Bronze to Mr. Ronald Frank George for his paper "A New Calculation of the Poverty Line" read to the Study Group in October, 1936, and published in the *Journal*, Part I, 1937.

The Frances Wood Memorial Prize, value £30, was awarded in March 1938 to Mr. R. Huws Jones for the paper on "Physical Indices and Clinical Assessments of the Nutrition of School Children," which was read at the meeting of the Society in November 1937 and published in Part I of the *Journal* for 1938.

The list of New Year Honours, 1938, included the names of two members of the Council, Mr. William Palin Elderton, C.B.E., F.I.A., F.F.A., who received a knighthood, and Dr. E. C. Snow, who was made a Commander of the Order of the British Empire. A former member of the Council, Mr. Duncan Wilson, received a knighthood.

Mr. R. H. Coats of the Dominion Bureau of Statistics, Ottawa, who has beeen an Honorary Fellow of the Society since 1924, has been elected President of the American Statistical Association.

Mr. H. Leak, a member of the Council from 1933 to 1938, has been elected a member of the International Statistical Institute.

In the list of Birthday Honours published on June 9th, it was announced that a barony had been conferred on Sir Josiah Charles Stamp, G.B.E., D.Sc., LL.D., F.B.A., President of the Society from 1930 to 1932.

The Manchester Statistical Society and the Royal Statistical Society addressed a joint Memorial to the Board of Inland Revenue asking them to consider the resumption of the publication of the estate duty figures by age and sex categories. The request was acceded to; the latest report of the Commissioners gives the details for 1936 and similar details are to be given at regular intervals in the future.

The abstract of the Treasurer's account of receipts and payments for the year 1937 and the balance sheet at December 31st, 1937, together with the report of the Auditors thereon, are given in Appendix A. Comparative figures relating to finance and to the numbers of Fellows are shown in Appendix B.

The state of the Society's finances in 1937 was somewhat better than in the previous year, for, although there was again an excess of payments over receipts, the amount of the excess was £64 in 1937, against £275 in 1936. The improvement is mainly due to a decrease of £187 in the cost of the *Journal*, coupled with an increase of £49 in the *Journal* receipts. On the other hand, there was an increase of £38 in the net cost of the *Supplement*. The cost of producing the

Journal and the *Supplement* is not altogether susceptible of control; it depends largely on the amount of mathematical and tabular setting, which is governed by the nature of the subject-matter in each instance.

The Fellows named below (nominated in accordance with Bye-law 14) are recommended for election as President, Council, and Officers of the Society for the Session 1938–39 :—

President

Professor A. L. Bowley, C.B.E., Sc.D., F.B.A.

Council

*Sir Percy Ashley, K.B.E., C.B.
W. A. Basham, O.B.E.
J. Bonar, LL.D., Litt.D., F.B.A.
*A. M. Carr-Saunders.
J. Iris Douglas.
Major P. Granville Edge, O.B.E.
Barnard Ellinger, C.B.E.
G. S. W. Epps, C.B., C.B.E., F.I.A.
Dorothy P. Etlinger.
*R. F. George.
*Sir Gwilym Gibbon, C.B., D.Sc.
R. G. Glenday, M.C.
*R. G. Hawtrey.
A. Bradford Hill, D.Sc.
J. O. Irwin, Sc.D., D.Sc.
Leon Isserlis, D.Sc.
Professor J. H. Jones.
A. W. Waterlow King.
Sir Harry Lindsay, K.C.I.E., C.B.E.
H. W. Macrosty, O.B.E.
Professor Egon S. Pearson, D.Sc.
George Rae, D.Sc.
E. C. Ramsbottom, O.B.E.
E. C. Rhodes, D.Sc.
E. C. Snow, C.B.E., D.Sc.
J. Calvert Spensley, O.B.E.
*Percy Stocks, M.D.
A. D. Webb, C.B.E.
John Wishart, D.Sc.
F. Yates.

Those marked * were not Members of Council during the preceding Session.

Honorary Treasurer

A. W. Waterlow King.

Honorary Secretaries

H. W. Macrosty, O.B.E.
E. C. Snow, C.B.E., D.Sc.
Leon Isserlis, D.Sc.

Honorary Foreign Secretary

E. C. Snow, C.B.E., D.Sc.

Signed on behalf of the Council,
KENNET,
President.

H. W. MACROSTY,
E. C. SNOW,
L. ISSERLIS,
} *Hon. Secretaries.*

June 21*st*, 1938

APPENDICES

APPEN

(i) RECEIPTS AND PAYMENTS ACCOUNT FOR

Year 1936. £	*s.*	*d.*	RECEIPTS.	Year 1937. £	*s.*	*d.*
			Annual subscriptions :—			
1,476	*6*	*0*	For current year (705½)	1,481	11	0
126	*0*	*0*	Arrears (72)	151	4	0
69	*6*	*0*	In advance (28)	58	16	0
1,671	*12*	*0*		1,691	11	0
436	*2*	*0*	Dividends and interest (including income tax refunded)	439	8	7
771	*1*	*7*	Journal sales (including reprints) ...	808	16	10
14	*7*	*3*	,, advertisements	26	1	6
94	*17*	*1*	Sale of Supplement	112	6	6
4	*9*	*8*	,, other publications	2	12	9
10	*10*	*0*	Special subscription	10	10	0
7	*10*	*0*	Study Group subscriptions	11	10	0
50	*0*	*0*	Royal Economic Society	75	0	0
	8	*1*	Miscellaneous		11	3
3,060	*17*	*8*	Total of Ordinary Receipts	3,178	8	5
44	*2*	*0*	Life Compositions	92	8	0
1,036	*4*	*11*	Special receipts on account of removal.	—		
4,141	*4*	*7*		3,270	16	5
274	*19*	*4*	Excess of Payments over Receipts ...	62	2	7
£4,416	*3*	*11*		£3,332	19	0

DIX A

THE YEAR ENDED DECEMBER 31ST, 1937

Year 1936.			PAYMENTS.				Year 1937.		
£	s.	d.					£	s.	d.
			Journal (including reprints) :—						
742	*8*	*2*	Printing and paper				612	8	11
111	*10*	*0*	Reviewing				74	10	0
21	*12*	*0*	Reporting				21	8	6
104	*3*	*7*	Distribution				87	12	10
5	*9*	*0*	Repurchase				1	7	0
985	*2*	*9*					797	17	3
131	*5*	*9*	Meetings (including printing and postage)				123	12	0
47	*8*	*0*	Library books				71	16	7
48	*15*	*9*	„ binding				84	15	8
1,040	*1*	*5*	Salaries and wages				1,022	0	8
47	*12*	*3*	Pension				63	9	8
380	*0*	*0*	Rent				380	0	0
1	*19*	*7*	Land tax				—		
13	*9*	*0*	Insurance				23	3	6
90	*0*	*4*	Heating, light and water				113	6	2
44	*3*	*7*	House expenses				32	10	6
39	*15*	*1*	Furniture and equipment				11	11	3
68	*1*	*10*	Postage, carriage, and telephone ...				60	16	10
125	*3*	*0*	Stationery and miscellaneous printing				134	7	9
			Research Section :—	£	s.	d.			
46	*5*	*6*	Meetings	49	4	10	300	5	0
195	*3*	*7*	Supplement	251	0	2			
12	*19*	*9*	Study Group expenses				9	8	10
14	*12*	*4*	Miscellaneous				11	9	4
3	*17*	*6*	Guy Medals				—		
3,335	*17*	*0*	Total of Ordinary Expenditure ...				3,240	11	0
44	*2*	*0*	Amount carried to Life Composition Fund (see Balance Sheet) ...				92	8	0
1,036	*4*	*11*	Expenses of removal to Portugal Street.				—		
£4,416	*3*	*11*					£3,332	19	0

APPEN

(ii) BALANCE SHEET

Year 1936. £	*s.*	*d.*	LIABILITIES.	Year 1937. £	*s.*	*d.*
71	*8*	*0*	Advance annual subscriptions ...	58	16	0
99	*18*	*4*	Advance Journal and Supplement subscriptions	111	9	4
53	*0*	*2*	Bank advance	24	8	11
303	*11*	*11*	Sundry creditors	354	0	4
527	*18*	*5*		548	14	7
1,965	*12*	*0*	Life composition fund (including £92 8*s.* for Life Compositions received in 1937)	2,058	0	0
7,105	*18*	*10*	Balance in favour of the Society (exclusive of (1) Books in Library, (2) Journals and other publications in stock, and (3) Pictures, Furniture and Fixtures)	6,969	19	11
£9,599	*9*	*3*		£9,576	14	6

(iii) BUILDING FUND (ESTABLISHED JULY 10TH, 1873)

On December 31st, 1936, the Fund consisted of £788 4*s*. 2*d*. 3½ per cent. Conversion Loan and a cash balance of £92 1*s*. 9*d*. The dividends received during 1937 (£27 16*s*. 5*d*.) were invested in £27 15*s*. 11*d*. of the same stock, and the Fund now consists of £815 16*s*. 1*d*. 3½ per cent. Conversion Loan (market value December 31st, 1937, £834 12*s*.), and a cash balance of £92 1*s*. 9*d*. to be re-invested.

(iv) FRANCES WOOD MEMORIAL FUND (ESTABLISHED MAY 13TH, 1920)

On December 31st, 1936, the Fund consisted of £600 4 per cent. Preference Stock, London, Midland and Scottish Railway, and £37 4*s*. 4*d*. cash deposited in the P.O. Savings Bank. During 1937 dividends of £18 3*s*. were received, and the Fund was credited with £5 4*s*. 6*d*. income tax refunded and £1 3*s*. 4*d*. interest on the cash deposit and was debited with £30 for a prize. Thus at December 31st, 1937, the Fund consisted of £600 4 per cent. Preference Stock, London, Midland and Scottish Railway (value at December 31st, 1937, £492) and £31 15*s*. 2*d*. cash in the Post Office Savings Bank.

DIX A (*contd.*)

AT DECEMBER 31ST, 1937

Year 1936. £	*s.*	*d.*	**ASSETS.**	Year 1937. £	s.	d.
			Investments, at cost or under :—			
1,185	*0*	*0*	£2,236 11*s.* 3*d.* 2½% Consols (General Fund)	1,185	0	0
5,580	*0*	*0*	£10,527 12*s.* 3*d.* 2½% Consols (Guy Bequest)	5,580	0	0
1,299	*0*	*0*	£1,841 3½% Conversion Loan ...	1,299	0	0
490	*0*	*0*	£500 3½% War Loan	490	0	0
800	*0*	*0*	£1,169 17*s.* 6*d.* 3% Local Loans Stock	800	0	0
100	*0*	*0*	£666 4% 2nd Pref. Stock, L. & N.E. Rly.	100	0	0
25	*0*	*0*	£266 5% Prefd. Ord. Stock, L. & N.E. Rly.	25	0	0
9,479	*0*	*0*	(Market value, Dec. 31, 1937, £13,134)	9,479	0	0
			Cash : £ *s.* *d.*			
			On deposit ... ... —			
			On current account ... —			
			In hand 7 1 11			
5	*7*	*9*		7	1	11
84	*0*	*0*	Arrears of annual subscriptions recoverable (say 40)	84	0	0
31	*1*	*6*	Sundry debtors	6	12	7
£9,599	*9*	*3*		£9,576	14	6

REPORT OF THE AUDITORS

"We have examined the foregoing Receipts and Payments Account, Balance Sheet, and Statements in regard to the Building Fund and the Frances Wood Memorial Fund with the Books and Vouchers of the Society and find them to be in accordance therewith. We report that the Balance Sheet is, in our opinion, properly drawn up, so as to exhibit a true and correct view of the state of the Society's affairs, as shown by the Books. We have verified the Investments and Cash balances."

(SIGNED) BARNARD ELLINGER.
R. F. GEORGE.
ARTHUR M. SOUTHALL.

March 1st, 1938.

APPEN

STATEMENT OF THE CONDITION OF THE SOCIETY

Year.	Constitution.				Fin					
	Number of Fellows at end of Year.		Changes during the Year.		Receipts.					
	Totals.	Life Fellows included therein.	Gains by Election, &c.	Losses by Death, &c.	Annual Subscriptions.	Compositions.[1]	Dividends, Interest, &c.[2]	Journal Sales.[3]	Other Items	Totals.
					£	£	£	£	£	£
1913	846	174	53	61	1,331	84	341	294	58	2,108
1914	821	169	39	64	1,281	42	339	271	51	1,984
1915	772	163	12	61	1,243	63	319	268	32	1,925
1916	758	163	34	48	1,181	42	284	325	18	1,850
1917	757	161	40	41	1,186	53	276	311	130	1,956
1918	761	167	47	43	1,132	222	456	305	3	2,119
1919	796	172	91	56	1,297	273	276	603	10	2,459
1920	882	180	123	37	1,373	251	291	730	95	2,740
1921	946	186	112	48	1,481	231	603	662	39	3,015
1922	969	187	71	48	1,499	126	454	689	142	2,910
1923	996	195	66	39	1,476	242	506	739	114	3,075
1924	1,002	194	68	62	1,638	105	400	666	81	2,890
1925	1,030	195	79	51	1,611	189	399	807	43	3,049
1926	1,054	197	77	53	1,619	116	404	780	112	3,031
1927	1,074	199	62	42	1,665	84	376	792	84	3,001
1928	1,079	201	56	51	1,680	84	397	748	87	2,996
1929	1,076	202	61	64	1,804	137	400	866	124	3,331
1930	1,058	204	50	68	1,663	126	451	1,026	680[4]	3,946
1931	1,064	208	62	56	1,667	115	452	948	80	3,262
1932	1,031	210	46	79	1,621	126	460	824	54	3,085
1933	1,024	205	56	63	1,586	21	435	723	122	2,887
1934	1,037	207	62	49	1,625	136	442	756	67	3,026
1935	1,051	205	67	53	1,673	84	436	864	96	3,153
1936	1,049	200	62	64	1,672	44	436	866	1,123[5]	4,141
1937	1,063	203	59	45	1,692	92	439	921	127	3,271

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[1] Life Compositions have been carried to a special Fund from 1921 onwards, and are included among the payments in "other items" column.

[2] Exclusive of the Building and Frances Wood Memorial Funds.

[3] Includes sales of Supplement from 1934 onwards.

[4] Includes £600 from sale of *Times* in 1930.

[5] Includes £1,036 special receipts on account of removal.

DIX B

DURING THE LAST TWENTY-FIVE YEARS, 1913–1937

ance.								
Payments.							Market Values of Investments at end of Year.	Year.
Journal.[6]	Meetings.[7]	Library (Books and Binding)	Salaries and Wages.	Rent.	Other Items.	Totals.		
£	£	£	£	£	£	£	£	
658	76	79	632	380	233	2,058	10,092	1913
793	82	88	615	380	361	2,319	9,528	1914
458	64	40	480	380	222	1,644	8,182	1915
516	50	36	492	380	181	1,655	7,702	1916
413	71	54	516	380	199	1,633	7,656	1917
651	91	33	534	380	211	1,900	8,282	1918
774	86	50	645	380	349	2,284	7,672	1919
913	89	99	904	380	454	2,839	6,848	1920
900	110	94	954	380	390	2,828	7,605	1921
983	98	103	1,006	380	755[8]	3,325	8,605	1922
922	146	107	1,010	380	445	2,940	8,666	1923
947	127	138	1,022	380	357	2,971	8,962	1924
940	132	116	1,021	380	373	2,962	8,423	1925
1,144	131	98	991	380	366	3,110	8,122	1926
1,213	150	119	899	380	302	3,063	8,375	1927
835	136	104	793	380	517	2,765	8,343	1928
839	150	156	878	380	238	2,741	8,462	1929
841	151	120	864	380	408	2,764	9,636	1930
903	147	206	921	380	376	2,933	9,151	1931
1,053	161	235	1,005	380	384	3,218	12,908	1932
809	149	96	1,001	380	330	2,765	13,167	1933
1,061	194	103	1,001	380	712[9]	3,451	15,839	1934
1,114	185	117	1,071	380	489	3,356	14,897	1935
1,180	178	96	1,040	380	1,542[10]	4,416	14,645	1936
1,049	173	157	1,022	380	552	3,333	13,134	1937

[6] Includes Supplement from 1934 onwards.
[7] Includes meetings of the Research Section from 1934 onwards.
[8] Includes £395 for Catalogue printing in 1922.
[9] Includes special expenditure on Library and grant to Centenary Fund.
[10] Includes £1,036 expenses of removal and equipment of new premises.

PROCEEDINGS OF THE ONE HUNDRED AND FOURTH ANNUAL GENERAL MEETING OF THE ROYAL STATISTICAL SOCIETY, HELD IN THE HALL OF THE ROYAL SOCIETY OF ARTS ON TUESDAY, JUNE 21ST, 1938.

THE Chair was taken by the President, the Right Honourable LORD KENNET OF THE DENE, P.C., G.B.E., D.S.O., D.S.C., at 5.0 p.m.

The HONORARY SECRETARY, after reading the notice convening the meeting, presented the Report of the Council for the financial year 1937 and for the Session 1937–38, proofs of which had been circulated to the Fellows present, and drew attention to the main points covered.

The HONORARY SECRETARY then moved that the Report be adopted and printed in the *Journal*; on being seconded by Dr. E. C. Rhodes the motion was carried unanimously.

The HONORARY SECRETARY announced that in accordance with Bye-Law No. 9 the Council had ordered the names of twelve persons to be erased from the list of Fellows.

The CHAIRMAN presented Mr. R. F. George with the Guy Medal in bronze awarded to him by the Council for his paper "A New Calculation of the Poverty Line" read to the Study Group in October 1936.

Mr. Ramsbottom, to whom the Council had awarded the Guy Medal in silver, was unable to be at the meeting and the presentation to him was postponed until November.

A ballot was taken for the election of the President, Council, and Officers for the Session 1938–39, Mrs. R. F. George and Mr. Craft being appointed scrutineers. As a result it was announced that all those nominated had been elected to the several offices.

A cordial vote of thanks to the President and Council for their services during the past session was proposed by Dr. C. O. George, seconded by Mr. Trachtenberg, and carried unanimously.

The meeting then adjourned for the Ordinary Meeting.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

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2.—*Czuber* (*Emanuel*). Die Statistischen Forschungsmethoden 755
3.—*Pedersen* (*J.*) and *Petersen* (*O. S.*). An Analysis of Price Behaviour during the Period 1855–1913 757
4.—*Neyman* (*J.*). Lectures and Conferences on Mathematical Statistics 758
5.—*Kelley* (*T. L.*). The Kelley Statistical Tables 760
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7.—Pilgrim Trust. Men Without Work 762
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10.—*Cowles* (*A.*) and associates. Common-Stock Indexes 1871–1937 767
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14.—*Hersch* (*L.*). Le Juif Delinquant 773
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1.—*A First Course in Statistics.* Their Use and Interpretation in Education and Psychology. By E. F. Lindquist, Professor of Education in the State University of Iowa, London : Harrap, 1938. 8¾" × 5½". xi + 223 pp. 8*s.* 6*d.*, together with *A Study Manual for A First Course in Statistics*, by E. F. Lindquist: 120 pp. 5*s.*

In his preface Professor Lindquist quotes a telling passage from Professor Helen Walker : "The longer the writer teaches statistics and the more dissertations she attempts to direct, the more profoundly does she believe that the chief challenge to teachers of research methods is not to produce good computers and not to produce people who can juggle algebraical formulas or who can invent new terminology and new procedures, but to improve the quality of logic which goes into research." Professor Lindquist has taken up this challenge and written a book with the object of training the reader in statistical logic. The result is highly successful.

The Socratic method is an integral part of Professor Lindquist's teaching technique. He has therefore provided, in addition to his book, a study-manual of about three hundred questions for the main part based on concrete situations with which the student may find himself faced. It is a characteristic and very valuable feature of the manual that it is designed to illustrate the limitations as well as the uses of the statistical methods discussed in the book. None of Professor Lindquist's questions has the lifeless appearance of most statistical exercises, and some of them are pleasantly ingenious. Here, for instance, is one of his examples on the comparison of the mean and the median.

"A trucking concern has kept statistics for several years on two makes of tires. It has found that the *median* length of life is 15,000 miles for tire A and 17,000 for tire B, but that the *mean* length of life is 17,000 for A and 15,000 for B.

" Assuming that both makes sell for the same price, which make should the concern buy in the future? Why?

" If you were buying a single tire for your own car, which make would you buy? Why? "

And here is a pretty exercise in the logic of bivariate distributions:

" Assume that the distributions of intelligence are identical for all married men in this country and for their wives (this includes the assumptions that the means and S.D.'s are equal for the two distributions). Is each of the following statements true? Why are they not inconsistent with each other?

" (1) Women of superior intelligence tend to be married to men who are above average in intelligence, but who are nevertheless inferior in intelligence to their wives.

" (2) Men who are above average in intelligence are usually more intelligent than their wives."

A final example might be recommended for study to the Listeners' Research Department of the British Broadcasting Corporation:

" In conducting a straw ballot to obtain an expression of current opinion on a political issue, a magazine sends ballots by mail to persons selected at random from the lists of registered automobile owners in a given state.

" (*a*) Discuss possible sources of bias in the data collected.

" (*b*) Another magazine mails similar ballots to persons selected from a list of registered voters at the last election. Discuss possible sources of bias."

A student who can give a reasoned dissertation on these and the other problems in the manual has his feet truly in the Path.

In the book itself Professor Lindquist has adopted the principle of covering a restricted area thoroughly rather than a large area cursorily. He deliberately minimizes the mathematical theory of statistics and the mechanics of computation; and he considers only a limited number of the techniques employed in educational and psychological work—nothing, for instance, is said of factor analysis and in the sections on sampling the only tests of significance described are those dependent on the use of standard errors. But it would be missing the point of his work to list the subjects which might have been included in it. With the requirements of his students constantly in mind, and with a wealth of practical experience in teaching statistics at his disposal, Professor Lindquist has given an excellent introductory account of frequency distributions, measures of central tendency and of dispersion, and correlation theory, together with a description of their scope in psychological and educational studies. No difficulties are glossed over, and his meaning is always clear.

Perhaps the chapter which will undergo the keenest scrutiny from statisticians is that entitled " Sampling Error Theory." Anyone who attempts a discussion of sampling technique on elementary lines is asking for trouble; but it appears to the reviewer that in the twenty-six pages which he has allowed himself Professor Lindquist has successfully skirted the major pitfalls. One or two suggestions might be made for future editions. For instance, it is not by any means certain that picking names out of a hat or choosing names every so often in a directory will yield a random sample. Such experimental evidence as exists is inconclusive, and there is a growing suspicion of many methods which were once accepted as random without question. At every turn bias rears its ugly head. Again, the author rightly stresses the fact that the normal distribution is not to be put on any kind of pedestal, even in psychology; but he does not give equal prominence to the fact that the use of standard errors in cases where a sampling distribution deviates very markedly from the normal (as for instance with a correlation coefficient in smallish samples from a highly correlated universe) is to be made with caution.

These are small points. The value of the book lies in the endeavours of the author to get the reader to think for himself and to realize fully what he is doing. Although addressed to students of education and psychology, the book can be read with profit by any beginner or intermediate student. It only remains to add that it is cheap, as statistical books go, and well turned out. M. G. K.

2.—*Die Statistischen Forschungsmethoden.* By Emanuel Czuber. Third edition, revised and supplemented by F. Burkhardt. Vienna: L. W. Seidel und Sohn, 1938. 9½″ × 6¾″. xvi + 330 pp. *Sch.* 27, cloth, *Sch.* 24, paper.

In order to classify properly the book under review, we must begin with a classification of the general scope of mathematical statistics. Its first and fundamental conception is generally accepted to be a population or a universe of some individuals. The object of statistics is to study the properties of populations which it will be convenient to call the collective characters. Here we come to the first point of subdivision of statistics: we may study the properties of some given collective characters in general, starting from their definition and without any reference to some specified population or we may try to determine the numerical values of some particular collective characters of a given population. When proving that the coefficient of correlation cannot exceed unity, whatever the population, we are dealing with the first type of problem. We are dealing with the second when we try to calculate the coefficient of correlation between, say, the stature of fathers and sons.

The problems of the first type constitute the scope of mathematical statistics, the problems of the second type may be described as those of practical statistics.

The problems of mathematical statistics could be usefully classified further. First of all we may distinguish the problems of descriptive statistics. These are the problems concerning the properties of collective characters, the relations between them and the methods of calculating under the assumption that the whole population considered is accessible for direct study. Various methods of calculating means, standard deviations, regressions, etc., come under this heading.

We have another type of problem when the population considered is not accessible for direct study and all we can do is to draw a random sample from it. How to use a random sample in order to draw conclusions concerning the population is the general scope of the theories of estimation and of testing statistical hypotheses.

Finally we may consider a third category of problems of mathematical statistics. It is known that the solutions of problems of estimation and of testing statistical hypotheses depend considerably on the method of drawing the random sample, which may be either unrestricted or subject to various limitations of randomness. The problems I have in mind refer to the connection between the methods of sampling and the accuracy of the final conclusions. They may be called the problems of sampling, though this term is sometimes used in a different meaning.

There is no doubt that, out of the three types of problems of mathematical statistics mentioned above, the most important is the first: if someone does not understand the meaning of the arithmetic mean, it is useless to try to teach him methods of its estimation from a sample or the methods of sampling giving the greatest accuracy of the estimate. This is probably the reason why the book under review gives so much space to descriptive statistics while the problems of estimation, of testing statistical hypotheses, and of sampling, are almost totally ignored.

As stated in the preface to the first edition, Czuber was induced to write a book on statistical methods by the notable success of Mr. Yule's *Introduction to the Theory of Statistics*. The main body of earlier editions of the *Introduction* was also concerned with descriptive statistics. But this was natural, because the other two sections of the theory have been worked out only recently. The last edition of the *Introduction* includes a number of important results of this kind.

Czuber followed the lines of the earlier editions of the *Introduction* but the book under review is even more "descriptive." As an account of the theory of descriptive statistics it is rather a success. It is fairly complete, accurate and easy to read. There are numerous examples, both borrowed and new. The first section deals with Yule's theory of attributes. The second is given to averages, measures of variability, correlation, indices and time series. The chapter on indices includes some interesting discussions of "biometric function." Dealing with time series, the authors are mainly concerned with the calculation of trends and of seasonal variations. The third section of the book is entitled "Bezugnahme auf die Wahrscheinlichkeitsrechnung," and might be expected to deal with problems of testing hypotheses, estimation and sampling. This to a certain extent it does. But, reading the section, one cannot help feeling that the authors did not like the subject very much and were reluctant to go into details. To illustrate my point I will give two examples.

The authors reproduce (p. 262) the results of Wolf's experiments with $n = 20{,}000$ die castings, and suggest a method of testing the hypothesis that the probabilities of the die falling on any of its sides are all equal to $p = \frac{1}{6}$. They do not mention the χ^2 method, but advise that the deviations of the observed from the expected frequencies be calculated and compared, each of them separately, with $3(np(1-p))^{\frac{1}{2}}$.

The other example is perhaps even more unexpected. Consider two series of n_1 and n_2 experiments respectively, and denote by k_1 and k_2 the numbers of occurrences of a certain event E. The authors treat the problem of testing the hypothesis that the probability p of E was in both series the same. They start with the assumption that the probability p is itself a random variable with a uniform distribution *a priori*, and calculate, separately for each of the two series, the mean of the *a posteriori* distribution. This is found to be, say, $p_i = (k_1 + 1)/(n_i + 2)$. Next they calculate the variances of the *a posteriori* distributions of p, again separately for the two series and get, say, $\sigma_i^2 = p_i(1 - p_i)/(n_i + 3)$. In order to decide whether the hypothesis of a common value of the probability of E in the two series of experiments should be rejected, the authors advise that $|p_1 - p_2|$ be compared with $3(\sigma_1^2 + \sigma_2^2)^{\frac{1}{2}}$.

As already mentioned, students interested in descriptive statistics will find this book very useful. As soon, however, as they have to deal with any problem in which the population studied is not directly accessible and an appeal to sampling is imperative, they will do well to seek advice from other sources. J. N.

3.—*An Analysis of Price Behaviour during the Period 1855–1913.* By Jørgen Pedersen and O. Strange Petersen. Copenhagen: Levin & Munksgaard, London: Humphrey Milford, 1938. $9\frac{3}{4}'' \times 6\frac{1}{2}''$. 268 pp. 12*s.* 6*d.*

Professor Jørgen Pedersen and his colleague have, in this volume, continued the study of wages and retail prices in Denmark, carried out under the auspices of the Institute of Economics and History and published in 1930, into the field of wholesale prices. The period covered is the same for this as for the previous enquiry, 1855–1913. For wholesale prices, material has been gathered mainly from two sources. The produce brokers' weekly prices-current has yielded 23 price-series, and the files of invoices relating to purchases of supplies for shipment to Greenland (the trade with which is a State monopoly) has provided 55 price-series. In the former group, annual prices have been obtained, generally, by taking the means of quotations at four-week, or at monthly, intervals. In the latter group, purchases made for shipment in the limited period during which navigation is open, and therefore liable to seasonal influence on the prices, are alone available. From other Danish sources weekly quotations for four additional articles have been secured, as well as prices paid by the City Hospital of Copenhagen for oatmeal. From outside sources six other price-series have been selected, four from the *Economist* (base metals) and two from the *Sauerbeck* records (coal and raw cotton). These 89 series of yearly prices are the primary material studied, but some tests are made of the relations between the variations recorded in these series and those shown for like articles in other countries—*e.g.* Sweden and England.

The study has two main features. On the one hand, the trend of the individual price-series is computed by taking rolling 11-year means. On the other, the fluctuations are measured by the percentage divergence of the figure for each year from the mean for the 11 years of which that year is the central year. The trend and fluctuation series thus cover the years 1860–1908. The authors direct especial attention to the series of what are described as "flexible prices," for which 25 or more of the 58 comparisons with the preceding year show change. The 28 "inflexible" price-series relate, of course, to manufactured articles ready for use by consumers, a description that may need qualification in the case of lime, lampblack and ochre. No foodstuffs are in this section, whether manufactured or not.

The grouping of the commodities according to the main influence on their price fluctuations, whether variations in demand or variations in supply, receives some attention. The similarity of shape, or lack of it, of the curves of trend, and of those showing deviations from the trend, receive the more detailed attention. The contention that the concept of a "general level" of prices is unacceptable appears, however, to be behind a large part of the interpretative discussion. Before accepting, as decisive on the point, evidence drawn from the data presented, it would appear not unreasonable to ask whether the selection of price-series used can claim to be representative of the field to which conclusions are to relate, whether that field be limited to Denmark, or, as is claimed, the world at large. In what, if any, degree this consideration has affected the selection of items, from the material placed under contribution, is not made clear. In what is stated, the conclusion that use has been made of all sufficiently continuous series in the material specified as from Danish sources is not negatived. The retention of separate series (the least "flexible" of all those used) for sewing-needles and darning-needles would appear to support this conclusion.

The choice of the 11-year sequence as the general basis of trend and fluctuation figures may not have been without influence on the comparison of results, just as the use of a single figure for each year may have obscured fluctuations of an importance comparable, at times, with those represented in the charts and tables given. It is not impossible, too, that the precise shade of meaning may, here and there, have been a little obscured in the process of rendering into English. The text is not entirely free from unusual translations, if they are not errors in copying or printing. These, and the classification of flannel among cotton fabrics, are, however, not likely to mislead readers. A. W. F.

4.—*Lectures and Conferences on Mathematical Statistics.* By J. Neyman. Washington: Graduate School of the United States Department of Agriculture, 1937. 10¼″ × 8″. 171 pp. $1.25.

This book contains the typescript of three lectures and six conferences given at the Graduate School of the United States Department of Agriculture in April 1937. To those who are unacquainted with Neyman's published papers, the volume gives a very readable survey of the nature and scope of the author's contributions to statistics in recent years.

The nature of the contents may be described by quoting the titles of the various addresses: "On the theory of probability," "Probability and experimentation," "The testing of statistical hypotheses," "Randomized and systematic arrangements of field experiments," "Certain problems of plant-breeding," "Statistical methods in social and economic research," "Time series analysis and some related statistical problems in economics," "Statistical estimation" and "An outline of the theory of confidence intervals."

Neyman is concerned throughout with the principles underlying modern statistical technique rather than with the latest practical developments. The sections dealing with controversial topics are especially interesting and give some insight into the reasons for the continued divergence between different schools of thought. For instance, if I read their meaning correctly, Neyman and Fisher both take the view that a mathematical technique for estimation must be judged by the properties of the estimates which it produces. Neyman further states (possibly a more debatable point) that the question—which are the most desirable properties of an estimate?—is to some extent at least a matter of taste. When one reads further (p. 159) in a comparison of the method of confidence intervals with the method of fiducial distributions that "the numerical results are the same. It is possible that they will be the same always. But the theories seem to differ," the gap between the two theories seems a somewhat elusive one.

In his discussion of controversial topics Neyman has been at pains to leave the reader free to form his own verdict. One may not always agree with Neyman's own final opinion. For example, in discussing the statistical analysis of a systematic half-drill strip experiment of the ABBA pattern, he gives the results of the application by C. Chandra Sekar of Student's latest method of obtaining an estimate of error to 120 experiments on uniformity trial data. This is summarized in a histogram showing the distribution of the 120 calculated values of t (the ratio of the mean difference between the two varieties to its estimated standard error). A continuous t-distribution is superimposed on the diagram. The fit is compared by Neyman's "smooth" test for goodness of fit and shows no significant deviation. It would, however, seem more appropriate to test whether the method was producing too many or too few apparently significant results. A suitable test for this is made by comparing the variance of the distribution of the observed t's with the expected variance of t, and this shows that the former variance is significantly too large—*i.e.* that on these data Student's method is liable to produce too many apparently significant differences. This result is of some interest, in view of Student's opinion that the method would, if anything, overestimate the real error.

The comments and questions asked by members of the audience are included, with the author's replies. W. G. C.

5.—*The Kelley Statistical Tables.* By Truman Lee Kelley, Ph.D., Professor of Education in Harvard University. London and New York: Macmillan, 1938. 11½″ × 8½″. xi + 136 pp. 20*s.*

This well-printed volume contains seven tables, the first giving to eight places the ordinates and deviates of the normal curve for given proportions of the area to the right of the ordinate, proceeding by steps of 0·0001; and the second giving some values of the χ^2 integral. The third, fourth and fifth give coefficients for use in the Lagrangean interpolation formulae of the third, fifth and seventh order. Table VI gives square roots of the numbers from 1 to 1000 and Table VII some frequently needed consonants. These last two are presumably included so as to have the quantities most frequently required by psychologists within the compass of a single volume, the square-root table being in no way an adequate substitute for such a table as Barlow's.

The deviates and ordinates of Table I were computed partly from the 10-place tables of Ethel M. Elderton and T. Kondo, reprinted as Table II of "Tables for Statisticians and Biometricians, Part II," and partly by direct calculation. The Elderton–Kondo table proceeds by steps of 0·001 of the argument, Professor Kelley's by steps of one-tenth the size. The resulting tables will probably be found very useful by most statisticians. The author has also included, together with the argument p, the values of $\sqrt{p(1-p)}$ $\sqrt{1-p^2}$ $\sqrt{1-(1-p)^2}$ and $1-p$, so that use may also be made of the tables in finding the standard errors of proportions and in finding partial correlation coefficients.

Table II gives the probability integral of χ^2 for an argument $\chi/\sqrt{n}$, where n is the number of degrees of freedom, proceeding by intervals of 0·1 from 0 to 4·1 and for values of n 1–10 inclusive, 12, 15, 19, 24 and 30. For low values of the argument the table may form some sort of supplement to the well-known table of Sir W. Palin Elderton, reprinted as Table XII in "Tables for Statisticians and Biometricians, Part I." It does not appear to add very much to knowledge for higher values of χ^2 or for moderate or large values of the number of degrees of freedom. The author says that by using $\chi/\sqrt{n}$ as the argument the accuracy of interpolation has been facilitated, and claims that "three-place accuracy in P can very generally be obtained for values of χ^2 and n other than those tabled by simple linear interpolation." But three-figure accuracy is not always attained in the place where it is most needed—*i.e.*, at the tail of the distribution. For instance, with 30 degrees of freedom the 1 per cent. of χ^2 is at 50·892. $\sqrt{(\chi^2/n)}$ is thus 1·3024, and if we interpolate linearly in Kelley's table we get $P = 0·0115$ against a true value of 0·01. Similarly, for 10 degrees of freedom and $\chi^2 =$ 23·209 we get $P = 0·0108$ against the true value of 0·01.

It is true that the so-called χ^2 integral is really an integral of χ; but in practice we meet only with values of χ^2, and it saves an extra step in the arithmetic to have the latter as the argument. It may well be doubted whether this extra step is rendered worth while by the increase in accuracy of interpolation over a part of the table where accuracy is hardly ever required.

Professor Kelley's reliance on the Lagrangean method of interpolation has relieved him from the necessity of tabulating differences; but their absence means that one has little guidance in determining how many figures in the result may be relied on.

In a short preface Professor Kelley makes a curious recantation of his earlier disbelief in the sacro-sanctity of the normal distribution, and feels it necessary to justify the labour expended on his first table on the grounds that " the sphere of usefulness of the distribution in connection with biological and psychological phenomena is extended." But surely the justification rests on broader grounds than those? In theoretical work at least the normal curve is firmly established, and Professor Kelley's first table would be a welcome instrument to put in any statistical workbag. M. G. K.

6.—*Tables of the Correlation Coefficient*. By F. N. David. Issued by the Biometrika Office, University College, London and printed at the Cambridge University Press, 1938. 11″ × 8½″. xxxviii + 55 pp., with 10 diagrams and 4 charts. 10*s*. net.

Twenty-four years have elapsed since R. A. Fisher found the distribution of the product-moment correlation coefficient in samples of any size from an infinite bivariate normal universe, and twenty-one years since his results were developed in the well-known " Co-operative Study " which appeared in *Biometrika* of 1917. The " Study " provided tables of the ordinates of the frequency curves of the coefficient, but hitherto no tables of the probability integral have been available. In this volume Miss David gives both ordinates and areas (to five places) of the frequency curves for values of ρ (the universe correlation) from 0 to 0·9 in steps of 0·1; values of r (the sample correlation), from -1 to $+1$ by steps of 0·05 with steps of 0·025 in the neighbourhood of the mode; and values of n (the number in the sample) for $n = 3$ to $n = 25$ inclusive, and for $n = 50$, 100, 200, and 400. Methods of interpolation for intermediate values are explained. It was originally intended that tables for $n = 800$ and $n = 1600$ should also be calculated, but experience showed that the labour involved would hardly be repaid by the utility of the results.

One of the most interesting facts emerging from the introduction to the table is the remarkable accuracy of Fisher's logarithmic transformation in testing significance, even for values of n as low as 11. On the other hand, Miss David shows that the usual assumption that, if ρ is not too close to unity, r may be taken to be normally distributed with standard error equal to $(1 - \rho^2)/\sqrt{(n-1)}$, is unsound even for samples of 400, and very unsound if $\rho > 0{\cdot}6$. She concludes that " it is probably wiser never to assume normality."

For practical work the four charts at the end of the tables are likely to prove very useful. These show (to probability levels 0·10, 0·05, 0·02, and 0·01) the chance of rejecting a hypothesis about the value of ρ when it is in fact true, for various values of r, ρ and n. Their use is explained and exemplified in the introduction on the basis of the Neyman–Pearson theory of testing hypotheses; but they can, of course, also be employed from the standpoint of Fisher's fiducial probability.

Presumably to save expense, the tables themselves are lithographed, and no differences are given. They are, however, uniformly clear and of the standard which we have learnt to expect from the Biometrika Office and the Cambridge University Press. M. G. K.

7.—*Men Without Work: a Report made to the Pilgrim Trust.* With an Introduction by the Archbishop of York and a Preface by Lord Macmillan. Cambridge University Press, 1938. 8½″ × 5″. 447 pp. 7*s.* 6*d.* net.

The Pilgrim Trust has done well in setting on foot the enquiry into "long" unemployment described in this book. Under the tutelage of Sir William Beveridge a small band of enquirers, one of whom, Mr. Oakeshott, a Winchester schoolmaster, has just been made head of St. Paul's School, has produced an able and most thorough study, which is of the greatest interest to all who are concerned about unemployment

The enquirers have used the "sample" method. Having carefully chosen six widely contrasted districts typical of the various aspects of unemployment—namely, Deptford, Leicester, Liverpool, Blackburn, Crook and the Rhondda—they took a random sample of those who were shown on the local Live Register to have been out of work for more than a year. In this way they collected about a thousand "cases," which they visited and investigated as completely as they knew how. In Deptford they found 92 of them, and examined them all. In the Rhondda, where there were very many more, they examined one in 40. They are aware of the danger of drawing sweeping conclusions from mere tables of figures, and it can be said that their opinions, which can be tested in other ways, do not rest on an unsound statistical foundation.

Of much of the book it is not possible in these notes to write at any length. There is, for instance, a helpful study of social service, of clubs for the unemployed, of "subsistence production" schemes and the like. There is much also about the physique of the "long" unemployed. Of the quarter of a million or so men whom they consider to be in this category the enquirers conclude that, while about half are fit for re-employment, over a quarter are likely to be employed only under abnormal conditions, and that about a fifth are unfit through physical defects.

The psychological effects of unemployment are also closely examined, the demoralization of the younger men, the hopelessness of the older, the attitude to work, the effect of unemployment on the home and on social standing, the oddly different results in different places. All this is deduced from concrete facts, and the conclusions would not surprise those who have intimate knowledge.

These discussions include a reference to the problem which is not infrequently met with of an unemployment allowance so close to the wages which are available as to weaken the incentive to work. The enquirers support the proposal for a system of family allowances, since it is mainly among men with large families that this matter arises, although in a note at the end of their discussion they allude to some of the difficulties of this plan. The relation of unemployment relief to earnings is, unfortunately, no new problem. It is familiar to students of the Poor Law in the doctrine of "less eligibility." This has been at no time a popular notion, but long experience would show that to have regard to it is not necessarily to be unsympathetic. Indeed, quite the reverse may well be the case. The scales of relief, whether they be insurance benefits or unemployment assistance allowances or public assistance payments, have a way of becoming a national minimum wage. That in turn, no matter what its actual money figure may be, tends to become the "poverty line" as well as a "wage rate." Whether we should supplement wages where there is a large family, which is what the enquirers recommend, or whether the doctrine of less eligibility should be applied, that is the question. One thing at any rate is clear, and that is that money that is not earned by the work of the man to whom it is given must be earned, if it is to be there at all, by the work of somebody else. It can also be said that the notion that real wages can be substantially and widely raised by a statute is unsound. What governs wages is the value of the work done for them, and this is a thing which cannot be regulated by statute. The wage level, indeed, is rather like the weather. You can predict about it, but you cannot control it.

But perhaps the most interesting part of the book, at any rate from the standpoint of the statistical presentation of unemployment, is the comment on the official unemployment figure. A study of long-term unemployment involves a contrast with short-term unemployment, and the enquirers remark that "it becomes increasingly apparent that the present practice followed in the official statistics of grouping together in one figure the turn-over of industry" (*i.e.* the short-term unemployment) "and the unemployed, who are now chiefly long unemployed, is no longer satisfactory." They point out that widely different kinds of unemployment are added together in the total figure. There are men just out of work, a large number, "many of whom would not be reckoned in some countries as unemployed at all." That is one extreme, while at the other are the long unemployed, those out of work for a year or more, the "hard core," numbering at the time of the enquiry 330,000, mostly men. At the worst of the trade depression this figure was as high as 460,000. Thus the total figure of unemployment, which is that commonly quoted in the public discussions, counts men who have been out of work for one day as equal with those who have been out of work for five years. This it is no doubt in the enquirers' view which is misleading. The queues of unemployed in the Rhondda, for example, are longer than those in Deptford, as is seen from the official statistics—seven times longer, in fact. What is not seen is that among every thousand workers 4 in Deptford but 280 in the Rhondda have been unemployed for at least a year. "The difference between a prosperous and a depressed area is thus not in the neighbourhood of 1 : 7 but of 1 : 70."

This is indeed a most important matter. The prosperity of Deptford and the depression in the Rhondda are both minimized in the public mind by the total unemployment figure, which is the figure commonly quoted. While this may not lead to an increase of pessimism in the Rhonddas, it certainly causes unjustified alarm in the Deptfords, and it is a hindrance to industrial transference and to remedial measures generally.

It is true that, if all of the published statistics are read, there will be found tables showing for the country as a whole, though not for each district, the varying lengths of unemployment. But these do not obtain much publicity. It would certainly be better if the main figures could be so arranged as to discriminate clearly between unemployment of different durations.

An analogy may throw light on the matter. Suppose that one wanted to know the number of people travelling on a bus from Oxford Circus to the Crystal Palace. Clearly one would find out how many tickets had been sold. It would at once be seen that they were mostly penny and twopenny tickets and that there would be very few sixpenny tickets for the whole journey. But in the main unemployment figure nothing useful is said about the different kinds of tickets.

The comment of the enquirers on this point is of great importance, coming as it does as the result of so thorough a study. "The inclusion of ins-and-outs in the unemployment figures must produce an entirely false picture of the differences in unemployment conditions in various parts of the country."

There is, however, one thing in the book which seems to be open to question. It is stated that long-term unemployment is "wholly a creation of the economic depression of 1930." This is deduced from the fact that in 1929 the number of persons on the Live Register who had been drawing benefit for over a year was estimated to be 53,000 only. But there must have been many more who were unemployed and not drawing benefit. This can easily be seen from the great and sudden increase in the number in 1930, which coincided with an easement in the conditions for the receipt of unemployment benefit. The number of persons drawing unemployment benefit who had paid less than 30 contributions in the preceding two years—this is a somewhat analogous figure, the other not then being regularly tabulated—was in February 1930 144,000. Next month it was 284,000. In June it had grown to 322,000. These persons were not previously employed to any extent. Otherwise they would have had the requisite contributions. They were unemployed and not in receipt of benefit, and many were not recorded at all.

It seems certain that at several periods in the past there have been "long-term" unemployed, living on their children or obtaining a precarious livelihood, whose unemployment was nowhere recorded. It would be most interesting to estimate what the number might have been in a depressed period before the war, supposing that there had been a monetary relief of unemployment like that now current, and that therefore the people had put their names down then as they do now. Perhaps some student of economics might be induced to write a thesis on it, examining old newspapers and records for information about soup kitchens and relief works and charitable funds and the doings of the Guardians.

But this is a minor criticism of what is really a masterly study of this nightmare of unemployment. It is greatly to be hoped that it will infuse the public discussions and contribute materially to an easement of the problem. J. A. D.

8.—*Kapitalbildung*. By J. Marschak and W. Lederer. London, Edinburgh and Glasgow: William Hodge & Co. 1936. 6¼″ × 9¼″. viii + 315 pp. Price 10*s*. 6*d*.; bound 12*s*. 6*d*.

This volume, printed in Germany and in the German language, and issued by a British publisher, owes its preparation to the Rockefeller foundation. Dr. Marschak has contributed a theoretical examination of the fundamental concepts to be dealt with, and their relations, which surveys the ground to be covered by the statistical data for the half-dozen countries of greatest importance (U.S.A., U.K., France, the Netherlands, Switzerland, Germany) gathered and compared in the remainder of the volume, mainly the work of Dr. Lederer.

The introductory essay is an admirable exposition of its subject, and provides guide-posts that should be valuable to readers seeking to determine the true significance of the somewhat confusing statistical data available for international comparison. The statistical material that follows falls short of the theoretical discussion in quality—and in completeness—though it may serve to show what are, in fact, the data at present accessible to the student and investigator. The figures for each of the six countries named above are given in separate sections, in which the various tabulated data are explained as well as stated. To these six sections there is prefixed a general memorandum, in which comparisons are made between certain of the data. In spite of a good deal of discussion of the range of error (*i.e.* uncertainty) of the data set forth, the varying degrees of trustworthiness of the basic figures cited appear to escape examination. A much more bulky volume, appealing to an extremely limited class of readers, would have been needed had this side of the question been canvassed. That it might not have been superfluous may be illustrated by the statements regarding one particular feature. A comparison of the extent of "Selbstfinancierung" in the several countries (p. 93) in the period 1925–30—as contrasted with dependence on the savings of others—credits Great Britain with meeting over five-eighths of its long-term investments in this way. The simple average of the corresponding proportions for the other five countries is one-fifth. Figures of allocations of profits to reserve funds, quoted from Mr. Colin Clark's calculations, serve as the basis for the figures of self-financing in British industry. The simple consideration of the estimated total of new investment, together with the aggregates of capital issues after deduction of those for overseas and for refunding purposes, should have made it obvious that much more than a half of the investment was met by drawing on external sources of supply. This kind of comparison of the data presented is of at least as great importance as the devising of calculations that will reconcile the series of annual figures of saving with those of investment, or, in the terms employed, of money-capital formation and material-capital formation. This latter task has been undertaken with a success that is more striking than convincing. It may be noted, incidentally, that for the U.S.A. the proportion of total new investment financed from the resources of industry itself is estimated at 13·5 per cent. The contrast of this figure with Dr. Carl Snyder's belief that the great bulk of new capital is derived from industry itself in his country, is as remarkable as the conclusion that the situation thus described has been reached in the United Kingdom. Ample evidence to the contrary is presented by the authors. A. W. F.

9.—*Les Variations du Mouvement Saisonnier dans l'Industrie de la Construction.* By Horst Mendershausen. Geneva: Georg & Cie. 1937. 8¾″ × 6¼″. 209 pp. *F.* 6.

Of recent years the problem of extracting seasonal variations has occupied a great deal of attention among economic statisticians. Innumerable methods have been suggested and are being used in practice to eliminate seasonal movements. The majority of these methods have, however, two characteristics in common. They are concerned hardly at all with the study of the variation itself, since the object of the analysis is simply to obtain a smooth series after the corrections have been applied. Further, the extraction is made not by a careful examination of the factors influencing the deviations from the trend level of activity in each separate month, but by the application of a mechanical, though sometimes very complicated, method for the purpose of obtaining a constant or gradually changing normal seasonal pattern.

The unsatisfactory results obtained in some cases by this type of analysis has led to a different approach. It has been noticed, for example, by Gjermoe and Wisniewski, that the seasonal amplitude is affected by the trend level of activity in such a way that the ordinary methods of calculating the absolute or relative deviations from trend, or some analogous function, give absurd results. The idea is therefore propounded that the level of activity should be introduced in some way as an independent determinant of the amplitude of the seasonality in any year, and the results obtained by the use of this hypothesis are shown to be greatly superior to those obtained previously. Here is the beginning of a break with mechanical methods and an attempt to introduce an analysis running in part at least in terms of causality.

It is the great merit of this investigation that it breaks completely with the earlier approach in substituting a causal analysis for a mechanical one. The extraction of seasonal movements is presented as a final stage after the causes of the monthly variations have been minutely examined.

After an interesting discussion of previous methods for dealing with the problems of seasonality, the author explains his own attitude to the matter, and discusses in the greatest detail his analysis of the factors determining seasonality in the construction industries of Belgium, Denmark, Germany, Great Britain and Holland. His method in general is as follows: He first takes a series of employment percentages for, say, insured workers in the Building Industry in Great Britain, and transforms this series into relative deviations from a twelve-months' moving average. He then takes each individual month in turn and considers what factors may be expected in theory to determine the variations in the set of trend deviations for that month. For example, for the winter months December, January and February, two determining variables, the level of employment in September and October as indicative of the cyclical level of employment, and average temperature in the month in question indicating the state of weather conditions, were chosen. Once the factors determining the value of the trend deviation have been analysed theoretically and their numerical significance has been computed by means of correlation technique, the author shows how the regression equations obtained can be used to build up a series adjusted for seasonal variation on the basis not of mechanical manipulation, but of causal analysis. The results are of great interest, and are compared in the case of Germany with those obtained by a mechanical formula.

The value of the work lies in the successful application of rational methods. Although these may seem laborious and may present great difficulties in some industries in which neither the cyclical state of activity nor comparatively simple measures of weather conditions determine the deviations from trend of the series, this study deserves a wide circulation among research workers concerned with the analysis of seasonal movements. It is also interesting as an application of correlation and regression technique.

The book is lavishly illustrated with charts and contains a useful bibliography, but, unfortunately, no index.

In conclusion it may not perhaps be out of place to mention two articles by the author, both in English, appearing in *Econometrica.* Both deal with aspects of the subject-matter of this book. The first, "Methods of Computing and Eliminating Changing Seasonal Variations," appeared in the issue for July 1937, and the second, "An Example of Meaningful Curvilinear Regressions in Economic Time Series," appeared in the issue for October of the same year.

R. W. S.

10.—*Common-Stock Indexes 1871–1937.* By Alfred Cowles 3rd and Associates. Cowles Commission for Research in Economics. 1938. Principia Press. 10″ × 7″. xii + 499 pp. $6.

This book is monograph No. 3 of the Cowles Commission for Research in Economics, and is concerned almost entirely with the discovery of facts. The magnitude of the work can be gauged from the consideration that in a book of this size almost all but the first 65 pages are occupied with the final numerical data.

The introduction, though brief, explains clearly the nature of the investigation. A short section on the importance of common stocks is followed by a description of the concepts to be measured, the period covered and the data employed. Next comes an especially interesting section on the algebra of index numbers applied to the question of stock-price measurement. The discussion begins with the introduction of Fisher's "ideal" index number (*i.e.*, the square root of the product of the two indices suggested respectively by Laspeyres and Paasche), and shows what modifications may and must be made in applying this index to the measurement of changes in stock prices with as little labour as is compatible with sound results.

In the first place it is permissible in practice, where share prices are weighted by the number of outstanding shares, to split Fisher's index and retain only the Laspeyres section (*i.e*,. $\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0}$). Next, owing to the changing set of shares entering into the index, it is desirable to convert Laspeyres' index into a chain index. Thirdly the nature of the information available in the early years and the labour of computing the *ps* call for some convention as to the figure which shall be taken to represent p in each month. The value chosen is the mean of the highest and lowest quotations. Finally, the very important question of the adjustments necessary to make allowance for changes in the capital structure of individual companies whose shares enter into the index is fully discussed.

The next section deals with the indices of the Standard Statistics Company, which, with certain minor differences due to the nature of the data available in the earlier period, are identical with those compiled by the Cowles Commission, so that the basic series of the latter can be brought up to date by means of the current figures compiled by the former, without any adjustment being made. Also practical tests are given to show that the assumptions made in the theoretical section do not lead to distortion, and the Cowles Commission series are compared with a number of other well-known indices, such as the *Dow-Jones* index, the *Annalist* index and so on. In a concluding section some of the important facts disclosed by the indices are briefly discussed.

In addition to the basic series of monthly stock prices, as ordinarily understood, compiled for all stocks and various subgroups, other series are presented in the course of this investigation. The first of these is described as an index of stock prices including cash dividends, and is designed to show the result to an individual investor if all dividends in cash or its equivalent were immediately reinvested in the common stocks of the groups of companies from which they came, the value ratios being adjusted to allow for the increased holdings which the investor acquired. This is regarded as a more realistic index of the experience of an investor than is given by the ordinary price series, but it is important to notice, as is mentioned in a footnote, that it can apply only to a single investor, and not to the whole body of investors. For if all investors behaved in this way, each would hold the same number of shares as before.

In addition to the above there are indices of: Yield Expectations, which are monthly series in which the prevailing annual dividend rate, multiplied by the number of shares outstanding, is shown as a percentage of total stock values; Yields, which are annual series in which the total dividend actually paid is expressed as a percentage of the average value of stock outstanding; Dividend Payments, which are annual measures of actual investor income obtained by multiplying Yields by Stock Prices; Earnings-Price Ratios, which are annual series in which total earnings for any given year are expressed as a percentage of the average value of stock outstanding in that year; and finally Earnings, which are series obtained by multiplying the last mentioned series by Stock Prices.

This work is an important contribution to our knowledge of stock-exchange movements, and the Cowles Commission is to be congratulated on a laborious undertaking which should be of the highest value to those engaged in the field of econometric research.

R. W. S.

11.—*Introduction to the Theory of Employment.* By Joan Robinson. London: Macmillan. 1937. $8\frac{3}{4}'' \times 5\frac{1}{2}''$. ix + 127 pp. *4s. 6d.*

"The purpose of this book," the author tells us in her foreword, "is to provide a simplified account of the main principles of the Theory of Employment for students who find that they require some help in assimilating Mr. Keynes's *General Theory of Employment, Interest and Money*, and the literature which is growing round it." The book, indeed, will be of service to all those who come to Mr. Keynes's work for the first time. That help is often needed, not only by students, is made very clear from a perusal of reviews of Mr. Keynes's work and commentaries upon it the world over, which show that the writers have failed to grasp the crucial points of Mr. Keynes's analysis. As a first book on the subject, it is naturally concerned with clarity of exposition rather than analytical refinements, and it is on the basis of lucidity that we must consider this introduction.

The book begins with a synopsis of the method of handling the subject, and goes on to consider Mr. Keynes's analysis in logical order. The author considers the equality of saving and investment, the multiplier, the effect of changes in investment and thriftiness, and from this argument considers popular remedies for unemployment. She goes on to deal with the part of prices in the economic system, the nature and importance of the rate of interest, and the effect of changes in the supply of money, with an appendix on the Quantity Theory. Then she takes the part of foreign trade, with an appendix on the Free-Trade controversy, and finally collects all the different sections to form the theory of the trade cycle. The last chapter is in the nature of a separate essay on sources and types of economic controversy which will be familiar to readers of her old but excellent pamphlet *Economics is a Serious Subject.*

Mrs. Robinson deals with the points essential to a grasp of the *General Theory* in an order that makes assimilation easy. First and most fundamental is the equality between the flow of savings and the flow of investment everywhere and at all times. This point Mrs. Robinson makes extremely clear. Once it has been understood, it follows that the active force is investment, and that the level of investment and the schedule of thriftiness determine total income.

It also follows that an increase in thriftiness, investment remaining the same, cannot lead to an increase in savings. Therefore there is no problem of what happens to an increase in savings following such an increase in thriftiness. An understanding of this last should help to solve the puzzles that have worried so many writers on Idle Balances and Hoarding.

From the above it also follows that changes in thriftiness cannot affect the rate of interest via changes in the flow of savings. This brings us to a further problem for the beginner—namely, what does determine the rate of interest? On this Mrs. Robinson is again extremely lucid; the equality of savings and investment is once more of fundamental importance, as can be seen by comparing the current theory of the Stockholm school with that of Mr. Keynes.

In all places where Mrs. Robinson has returned from Mr. Keynes's theory to previous theories, as in the appendix on the Quantity Theory, her remarks will be of the greatest value to the student, as the conflict between them is one of the most serious troubles that he has to face. Indeed, it might have made the subject easier for many readers if the "classical" theory of employment had been fitted into the *General Theory* as a special case. It is clear that in a world in which incomes are held constant, increased thriftiness must entail higher investment (although in the real world investment is likely to fall as a result of an increase in thriftiness owing to the effect upon entrepreneurs' expectations of a fall in consumption). Such a world, and more particularly the case in which continuous full employment is maintained with a stationary population and unchanging technique, is commonly assumed in systems of theoretical economics. It is fundamentally this divergence of assumption that is responsible for the cleavage between the views of Mr. Keynes and those of previous economic writers, and further for the difficulties of those who turn to the *General Theory* after some acquaintance with "classical" economics.

This book is conducted on a comparatively abstract plan, and is concerned more with the mechanism of a capitalist economy than with the causes of individual booms and depressions. In the very nature of such a work the basic assumptions are drawn more from intuition and common sense than from a minute examination of the details of the real world. This does no harm provided a critical attitude is adopted to the author's estimates—in common with Mr. Keynes—of the quantitative significance of the various factors involved. Mrs. Robinson would no doubt be the first to agree that an important next step is the quantitative estimation of the significance of the various determining variables. R. W. S.

12.—*La Population de la France, son Evolution et ses Perspectives*. By M. Huber, H. Bunle, F. Boverat. Paris: Hachette. 1937. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. xii + 249 pp. *Fr.* 30.

This book provides a very useful introduction to the census and vital statistics of France, and to the main trends in French population movements. For students there is certainly no better elementary study. With Messieurs Huber and Bunle treating the field of French population statistics, it is only to be expected that the material should be adequately handled. Monsieur Boverat's contribution is also useful, for it discusses Monsieur Sauvy's estimates of the future population of France and considers the economic and social consequences of the course of events implied by recent vital trends.

There are, however, one or two points which might perhaps be considered when a new edition of the book is prepared. First, it would be useful to extend the section on nuptiality and apply the principles of life-table construction to marriage data. In the section on fertility it would be useful to give comparative data for the Départements for periods earlier than 1930–32. In particular, gross reproduction rates are now available from 1890–1932, and show rather interesting trends. Further, in the section which discusses various indices of replacement, more attention might be given to the true rate of natural increase, for which only the approximate formula is stated. The Burgdörfer coefficient, too, needs somewhat extended discussion to show the conditions in which it gives a correct index of replacement. Finally, it would be very useful to have, in Monsieur Boverat's appendix, a survey of previous French attempts to stimulate fertility. They were quite numerous, and throw an interesting light on the place occupied by the population question in earlier periods. But these are merely suggestions, and do not in any way detract from the value of the present volume.

D. V. G.

13.—*Population Pressure and Economic Life in Japan.* By Ryoichi Ishii. London: P. S. King. 1937. $8\frac{3}{4}'' \times 5\frac{3}{4}''$. xix + 259 pp. *12s. 6d.*

The purpose of this study is to consider the extent of the disparity between Japan's economic possibilities and her population trends. In the first half Dr. Ishii sets out the problem. In the second he considers the possibilities and limitations of the various checks to the increase which he foresees.

He begins by depicting population trends and Government policies for population. Like China, Japan has from early times been densely populated compared with the West. From the seventeenth to early nineteenth centuries the relatively stationary population was kept down by the peaceful natural checks of abortion, infanticide, famine and pestilence. In 1868 came the Meiji Restoration, with the resultant passing of feudal Japan, the opening of the country to Western influence, and the Government-actuated beginning of the Industrial Revolution. The removal, by Government policy and the maturing of popular views, of the natural checks on the birth-rate of abortion and infanticide, together with a crystallization of opinion that Japan must have a large population if ever she was to become a first-class Power, led to a rapid increase of population fostered by Government policy. Since 1872 the population has doubled. The proportion employed in agriculture has decreased from over three-quarters to under half and practically the entire increase in numbers has gone into urban communities. As is characteristic of a rapidly growing population, at the present time the younger age-groups, with their high proportion of potential parents, are in strikingly high ratio to the others, and the net reproduction rate at 1·495 is among the highest in the world. To accentuate growth there are the falling death-rate—at present high—and the great potential improvements to sanitation and public health, which will probably cause it, especially the infant mortality rate, to decrease substantially. Altogether it seems inescapably clear that the Japanese population, which in 1935 was approximately 69 millions, is bound to grow in the next generation to between 80 and 90 millions despite promises of declining fertility. " In a crude sense, the crux of the Japanese population problem is the adequate disposal of this vast increment. . . . The absorption of this added labour force into productive channels is the real test of Japan's social and economic system."

Having stated the problem, Dr. Ishii proceeds to examine the Japanese economy to find a solution. He first sketches the rural economy. Expansion here is precluded by the restricted area of cultivable land, which has remained at roughly 15 per cent. of the total land area for the last thirty years, and the low standard of living offered by the land. Cultivation is by hand-labour exclusively, rents average the immense rate of over 50 per cent. of the crop, and there is much agrarian discontent. Dr. Ishii states that if the factors of production were adequately remunerated, Japanese agriculture would be operated at a sizeable loss. Hence the rural economy cannot be expected to absorb the surplus population, rather the reverse.

The author next considers food supply, which is essentially the supply of rice. 85 per cent. of rice consumed is domestic, and 12 per cent. comes from the Japanese colonies. Government efforts at price control have resulted in a tangled situation, but food supply will clearly be adequate for future needs.

The question of colonization and emigration is next discussed. Areas controlled by Anglo-Saxon races have been closed against Japanese, and only small numbers go elsewhere. Chinese hostility and competitive ability to oust the Japanese from agriculture and industry through their lower standard of life preclude much emigration to Manchukuo, the obvious area. Meanwhile immigration to Japan is twice annual emigration. Hence, until Manchukuo becomes attractive, emigration can offer no relief.

Next follows an examination of the prospects of greater industrialization. Progress has been phenomenal, and in many lines Japanese efficiency equals that of the most advanced Western nations. The ratio of production for foreign to domestic market is among the highest anywhere, and the proportion of manufactured to total exports has markedly increased in the last forty years. In areas around her, from India to the Philippines, Japan is gaining markets more rapidly than other nations, and economic nationalism by countries feeling Japanese competition has not yet proved seriously obstructive. Japanese industrial efficiency is rapidly increasing. Unemployment and social problems of maladjustment are of recent appearance, and not yet of such serious proportions as in this country.

Finally Dr. Ishii considers relief by birth control, but concludes that even with Government support it can barely modify present population increase, although it is of ultimate significance. He ends with summary and conclusions, and finds a solution in further industrialization with social reforms and improved distribution of national income.

The aspect that Dr. Ishii seems to have neglected is that with each new producer comes a new consumer. The home market of Japan is expanding, and will expand rapidly under the influence of increasing population, thereby absorbing a good proportion of the extra labour. There seems no reason why Japan's share of Eastern and Asiatic markets should not continue to expand, as it is expanding at present, to give employment in production for export. With continued industrialization, on this argument Japan should not face any insoluble problem of over-population, nor is there any insoluble food problem, given agrarian reform.

To the Western reader, who is in general ignorant of Japan and starved of serious literature on the subject, this unbiased and scholarly work will be of the highest service. Dr. Ishii has gathered an enormous amount of material into his book—there are 115 tables illustrating every aspect of his thesis—while the argument is lucidly presented, and extremely well documented. His digressions from the main subject, such as the chapter on the interpretation of Japanese population statistics, are also illuminating. This book can be wholeheartedly recommended to anyone who is interested in Japanese problems. R. W. S.

14.—*Le Juif Délinquant : Etude Comparative sur la Criminalité de la Population juive et non-juive de la République Polonaise.* By Liebmann Hersch. Paris: Alcan, 1938. 7¼″ × 4½″. 104 pp. 15 *fr.*

The publication by the Statistical Office of Poland of two comprehensive volumes of criminal statistics * derived from the records of the Courts of Justice, has provided material for establishing the relative degree of criminality of the Jews in a country where they constitute 9·6 per cent. of the total population. These records, which are analysed in detail with respect to categories of crime, localities, civil status, occupation, etc., relate only to the years 1924 and 1925, but summary figures were published for each of the years 1923–28 and the averages for the period are found to correspond closely with those of 1924–25. The detailed figures for these years have accordingly been taken by the author as a fair sample of all the data for the longer period. The average annual percentage of convictions of Jews to the total number of convictions for the six years period was 7·3 per cent. in what was formerly Russian Poland and 4·7 per cent. in Galicia, formerly Austrian (the first-named territory contains

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* *Statistique Criminelle.* Personnes condamnées et acquittées irrevocablement en 1924 et 1925, Varsovie, 1930.

73 per cent. of all the Jews in Poland, the latter 26 per cent.). Three main categories of crime are distinguished in the returns—namely, those against the State, against the person, and against property. The ratio of Jewish to non-Jewish convictions is, in the old Russian territory, 119 to 100 in the first category, 31 in the second and 40 in the third, the corresponding figures for Galicia being 117, 62 and 24. The rate per 100 of population for crimes against life by Jews is only one-seventh of the rate for non-Jews. The rate for robbery and theft is also comparatively low, the majority of Jewish convictions in this category being for fraud, as might be expected in a community predominantly commercial and urban. The character of the community also accounts for the preponderance among Jews of crimes against the State, consisting in great part of political misdemeanours, contravention of financial and commercial regulations, and evasions of army service and other obligations. The distribution of the convictions in the various subdivisions of crime and with regard to sex and age is analysed by the author in some detail, and is worthy of study. The facts are capably marshalled and clearly stated, with well-arranged tables and diagrams. It may be mentioned that a translation was published in the *Journal of Criminal Law and Criminality* (North-western University Press, Vol. XXVII, 1936).

C. T.

15.—*Other New Publications**

Butler (*Harold*). Problems of Industry in the East, with special reference to India, French India, Ceylon, Malay, and the Netherlands Indies. International Labour Office Studies and Reports, Series B. (Economic conditions), No. 29. Geneva (London: P. S. King), 1938. 74 pp. 9½" × 6¼". Price 1s. 6d.

[The author of this brochure spent three months in middle Asia in 1937–38 in order to obtain personal impressions of social and economic conditions there. He gives these impressions "amplified, corrected and verified by reference to documentary information obtained en route or already available in the International Labour Office." In an introduction he emphasizes the rapid growth of the East in economic importance and its incalculable capacity for production in the future—limited by one serious factor, the consuming power of the world. Although it has not made such rapid strides in industrialization (except in Japan), some progress has been made. China has made a beginning, and shows a rapid rate of increase. In India the index of the volume of industrial production has increased from an average of 100 for 1920–21 and 1921–22 to 151 for 1930–31 and 1931–32. In Ceylon, Malay and Netherlands Indies industry is still in its infancy, but is growing. The importance of estimating the economic and social consequences of Eastern industrialization is clear. To those who have not had the opportunity of studying Eastern social conditions personally, this work should prove an excellent introduction.]

Cowell (*F. R.*). Brief Guide to Government Publications. London: H.M. Stationery Office, 1938. 44 pp. 8½" × 5½". 3*d*.

["An attempt . . . to give examples from the vast output of the Stationery Office of publications, both parliamentary and non-parliamentary, under the few broad general subject headings used every month in the descriptive section of 'Government Publications,' the monthly catalogue of all new official documents."]

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* See also ADDITIONS TO LIBRARY, p. 800.

Frumkin (*Grzegorz*). Japan's Demographic Expansion in the Light of Statistical Analysis. Reprinted from the *Sociological Review*, Vol. XXX, No. 1, January, 1938. London: The LePlay House Press. 28 pp.

[Mr. Frumkin attacks the view of Japanese demographic expansion, held by the Japanese Institute for the Research of Population Problems among others, that, following two centuries of stagnant population, the increase when Japan became open to Western influences was caused by a "phenomenal jump" in the birth-rate, despite a simultaneously rising death-rate. Neither such a marked jump nor a rising death-rate, in view of the previous bad living conditions of the peasants, appear plausible to the author, and he re-examines the chaos of Japanese population statistics to find a different interpretation.

He studies the Tokugawa period, and concludes that a deliberate check on births by abortion and infanticide, combined with famine and disease, had ensured a stable, or even declining population. Nevertheless, recorded population was substantially lower than the actual. Hence the subsequent increase of population took place from a higher level. After the Meiji restoration from 1872 annual data of births and deaths have been available, but until 1920 comparisons of rates were unreliable because population enumerations were estimates with a large margin of error. A rapidly increasing birth-rate might be expected as the checks of abortion and infanticide were abandoned, but a subsidiary cause might be growing completeness of registration. Mr. Frumkin holds, however, that the death-rate cannot have actually increased, and any appearance of this must be due to more complete registration. It is interesting to contrast against this Mr. Yule's account of movements in the death-rate of a stable settled population—such as the Japanese—which is suddenly "jerked into a fresh cycle of growth—*e.g.*, by the advent of industry" (Presidential Address to R.S.S., Nov. 1924). Mr. Yule concluded that for a time death-rates would increase, owing to the higher rate among the mounting infant population.* Mr. Frumkin suggests again that the increase since the first modern census of 1920 may also have been over-stated through increasing completeness of recording. He concludes that the growth in the Meiji period was neither unique nor inexplicable. The present net reproduction rate, although high compared with Western Europe, was common in nineteenth-century Europe, and the increase of population, as happened in Europe, is due "to a time-lag between the improvement of mortality conditions and the decline in fertility."

Mr. Frumkin's deductions from Japanese vital statistics should be of interest to other students of this very thorny problem. A useful bibliography of sources is given.]

Henry (*Harry*). The Insurance Man and his Trade (Fact Library, No. 15). London: Fact Publishing Office, 1938. $7\frac{1}{4}'' \times 4\frac{1}{2}''$. 92 pp. Stiff paper 6*d*. Cloth 1*s*.

[A concise and telling summary of the main facts about "industrial assurance," or the business of assuring working-class lives, which was the subject of the important survey by Sir Arnold Wilson and Professor Herman Levy published some months ago and reviewed in this *Journal* (Part I, 1938, p. 219). In this effective and easily read form the importance of the matter should attract the attention of the general public, and so prepare the way for the reform of any evils inherent in the present system.]

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* Moreover, Mr. Yule assumes constant death-rates in age groups. The probable divergence from this in the case of Japan would go to strengthen his argument.

Neale (*E. P.*). Guide to New Zealand Official Statistics. Auckland University College Texts No. 2. Auckland, etc.: Whitcombe and Tombs, 1938. 94 pp. 8½″ × 5½″.

[This book describes the main sources of official statistics in New Zealand, the collection and compilation of the material, the methods of calculating the various index numbers, the chief limitations of the statistics and the pitfalls to be avoided in their use. Seven chapters are concerned respectively with statistics of population, meteorology, trade, justice, production and consumption, finance and industry, and the eighth and last with indicators of business conditions. As Professor Belshaw says in his foreword, the book throws light on general problems connected with the use and interpretation of statistics, and should therefore be of interest to all students of economics, business men, politicians, and others interested in economic and social problems, not only in New Zealand, but elsewhere.]

Walter (*Karl*). The Class Conflict in Italy. London: P. S. King, 1938. 8¼″ × 5¾″. 137 pp. 5*s*. net.

[This book is, rather unexpectedly, in the main a description of the industrial organization of modern Italy. Fascism, the author is at pains to show, was largely rooted in the trade-union movement of which Mussolini made himself the head, and at present 85 per cent. of the Party members are members of trade unions. The conflicts of pre-war days and the rise to power of the Fascists, sketched in the early chapters, are considered to have given impetus to the revolutionary changes in industry, hence the somewhat misleading title. The remainder of the book describes the complex machinery of corporative organization, the improvements which have been made in the conditions of labour and of working-class life, and the gradual development of national feeling in a people which, in spite of the political unification of the country, had remained predominantly regional in sentiment and interest. The future Italy is seen by the author as a co-operative trade-union state. The economic and industrial system described, however, is that of an organ within the body—as it were a digestive apparatus which nourishes the brain and limbs but cannot direct their activities—and it is not explained how a trade-union state is expected to function as an imperial nucleus.]

STATISTICAL NOTES

1. British Official Statistics

On page 780 we give our usual table summarizing the *oversea trade* of the United Kingdom for the years ended July 1937 and 1938. In July 1937 the value of exports reached the peak figure since the depression, and it is not surprising that in July last there was a considerable decline, or that the excess of imports over exports showed a small rise on the month—£31·9 million as compared with £31·1 million. The adverse merchandise balance was, however, less in July than the monthly average for the first half of the year; for the seven months the excess of imports amounted to £235·2 million, or £12·4 million more than a year earlier.

Imports in July, valued at £73,939,000, were £11,565,000 (13½ per cent.) less than in July 1937. As has been the case in recent months, the value of food, drink and tobacco imported was higher than a year earlier—by 7 per cent.—but there were substantial falls for both raw materials (27 per cent.) and manufactured articles (28 per cent.). Re-exports declined from £6,803,000 to £4,555,000, there being a heavy reduction in the value of each of the three main classes, varying from 27 per cent. for raw materials to 39 per cent. for manufactured articles.

Retained imports of food, drink and tobacco during July were valued at £35,440,000, or £2,833,000 more than a year earlier. There were increases of over £1 million for beverages and dairy produce and one of £1,549,000 for meat. The latter was due partly to higher prices for bacon and lamb, but mainly to much larger imports of mutton and lamb. The increase for dairy produce was due partly to larger imports of butter and eggs, and partly to the rise in price of butter. Half that for beverages and cocoa preparations was due to larger imports of tea, and half to a striking rise in imports of cocoa. There was, on the other hand, a decline of £1,305,000 for grain and flour, which was due essentially to lower prices. Retained imports of wheat rose from 8·2 million cwts. to 9·1 million cwts., but maize declined from 4·8 million cwts. to 3·7 million cwts. Among other foods may be mentioned a heavy increase in imports of sugar. For the first time this year, retained imports of tobacco failed to show a very substantial increase over those of last year.

Raw materials imported and retained declined in value from £23,718,000 to £17,284,000, or about the figure for July 1936. Half the decline was in respect of wood and timber, the quantity of sawn softwood imported showing, as in earlier months, a striking reduction. Most of the groups showed declines of lesser magnitude, but for wool, for the first time this year, the value of the retained imports was larger than a year ago. Previously there had been a small increase in the quantity retained, and for July there was a considerable rise. In the first half of the year retained imports of cotton fell by 148 million lb., but an increase of 20 million lb. was recorded for July. Declines exceeding £600,000 were recorded for iron ore and scrap, hides and skins, and oil seeds, oils, etc., but for rubber the change in value was unimportant, though the quantity retained rose by about 20 per cent.

Retained imports of manufactured articles declined from £21,988,000 to £16,106,000, the latter total being also less than that for July 1936. With one trifling exception, all the individual groups showed declines. Non-ferrous metals fell by £1,392,000 and iron and steel by £1,066,000. The former was due primarily to lower prices, and the latter to greatly reduced quantities. Imports of motor-cars were again very small. There was a considerable rise in retained imports of refined petroleum, following a record importation in the first half of the year.

Exports of United Kingdom goods fell from £47,595,000 to £37,470,000, a figure which was lower than in July 1936 by £2,616,000. The decline compared with last year was practically general, and among raw materials and manufactured articles increases were only recorded for two groups. Of these, that for machinery (£509,000) was substantial, but was due solely to higher prices. As in previous months, the decline in exports of food, drink and tobacco (£407,000) was primarily in respect of beverages (£353,000), there being a very general decline in exports of spirits. Exports of raw materials declined by £1,257,000 (21 per cent.) from the high figure of last year, over half of this being in respect of coal, exports of which previously had increased in value but decreased in quantity. The quantity of coal exported fell by 1,075,000 tons, there being reduced exports to practically all markets except Egypt. Nearly half the decline, however, was in exports to two countries—France (336,000 tons) and Sweden (179,000 tons). Average values, after rising almost continuously for over two years, fell slightly in July from 21*s*. 4*d*. to 21*s*. 2½*d*. per ton.

The value of manufactured goods exported declined from £37,401,000 to £28,963,000. The largest declines were recorded for cotton yarns and manufactures (£2,424,000), iron and steel

(£1,476,000) and woollen and worsted yarns and manufactures (£1,247,000). There was a substantial reduction of 97,000 tons (42 per cent.) in the quantity of iron and steel exported, but owing to higher prices, the fall in value was not so great (33 per cent.). The decline was general, being specially marked in respect of railway material. Exports of machinery were slightly less than in July 1937, there being, as in earlier months, substantial increases for electrical machinery and machine tools and a fall for agricultural tractors, while exports of textile machinery were also less than a year ago. Exports of motor-cars and chassis showed for the second month in succession a substantial decline. There was a general substantial reduction in exports of textiles. The quantity of cotton piece-goods exported fell from 177 million square yards to 113 million, the largest declines being 12 million square yards in exports to British West Africa and over 7 million in exports to the Dutch East Indies, but there were reduced exports to practically all markets.

There was again an excess of imports over exports of *bullion and specie* in July, but this was comparatively small (£3,364,000), the imports being considerably less than in recent months. The excess of imports over exports for the seven months amounted to £83 million, compared with £56 million a year earlier.

Measured by the Board of Trade index number of wholesale prices, the fall in *general wholesale prices* which had persisted during the first five months of 1938 showed some signs of arrest during June and July so far as industrial materials were concerned. Food prices, however, continued to fall, and in July were 5 per cent. below the level of a year ago. The fall in price was most noticeable in cereals, which decreased 7 per cent. since May 1938 and in July were rather more than 14 per cent. lower than in July 1937. On the other hand, the prices of non-ferrous metals increased nearly 5 per cent. during the two months, although still 24 per cent. below those obtaining in July 1937. There was also some appreciable rise in the prices of most textiles except wool, which has fallen more or less steadily during the preceding twelve months. Rubber advanced from 5·59*d.* to 7·40*d.* per lb. during the two months, and is now higher in price than in any month since October 1937. As compared with July 1937, basic materials (excluding fuel) showed in July 1938 a fall of 30·5 per cent. and intermediate products 8·1 per cent. The decline in the prices of manufactured articles and of building materials was much less (3 per cent. and 2 per cent. respectively). On the whole

Movements and Classes	Twelve Months ended July, 1937	Twelve Months ended July, 1938	Increase (+) or Decrease (−)
Imports, c.i.f.—	£'000	£'000	£'000
Food, drink and tobacco	406,053	446,067	(+) 40,014
Raw materials and articles mainly unmanufactured	286,797	288,794	(+) 1,997
Articles wholly or mainly manufactured	247,033	261,481	(+) 14,448
Other articles	5,843	6,838	(+) 995
Total Imports ...	945,726	1,003,180	(+) 57,454
Exports, f.o.b.—			
United Kingdom Produce and Manufactures—			
Food, drink and tobacco	38,043	36,630	(−) 1,413
Raw materials and articles mainly unmanufactured	60,421	59,083	(−) 1,338
Articles wholly or mainly manufactured	379,931	384,747	(+) 4,816
Other articles	13,167	12,838	(−) 329
Imported Merchandise—			
Food, drink and tobacco	12,656	12,529	(−) 127
Raw materials and articles mainly unmanufactured	38,034	29,511	(−) 8,523
Articles wholly or mainly manufactured	19,508	22,407	(+) 2,899
Other articles	475	728	(+) 253
Total Exports ...	562,235	558,473	(−) 3,762
Bullion and Specie—			
Imports	398,628	263,199	(−) 135,429
Exports	223,330	145,752	(−) 77,578

Movements of Shipping in the Foreign Trade—	Number of Vessels	Thousand Tons Net	Number of Vessels	Thousand Tons Net	Number of Vessels	Thousand Tons Net
Entered with cargoes—						
British	24,556	38,992	24,775	39,362	(+) 219	(+) 370
Foreign	26,985	30,214	27,608	30,777	(+) 623	(+) 563
Total entered ...	51,541	69,206	52,383	70,139	(+) 842	(+) 933
Cleared with cargoes—						
British	30,353	35,338	30,065	35,189	(−) 288	(−) 149
Foreign	22,777	24,365	22,064	24,271	(−) 713	(−) 94
Total cleared ...	53,130	59,703	52,129	59,460	(−) 1,001	(−) 243

there is not as yet any marked indication of an improvement in wholesale prices, or even of arrestment of the decline to warrant any considerable hope that the recession in trade and industry has reached its lowest point.

The Board of Trade index numbers of wholesale prices for the latest three months are given below :—

Averages for the year (1930 = 100).

Date	Total Food	Total not Food	All Articles	Basic Materials	Intermediate Products	Manufactured Articles	Building Materials
May, 1938 ...	100·4	102·7	102·0	90·5	104·8	111·9	104·1
June, ,, ...	99·4	101·3	100·7	87·3	103·9	111·4	103·7
July, ,, ...	97·8	101·9	100·6	89·3	103·9	111·7	103·6
July, 1937 ...	*102·9*	*116·1*	*111·5*	*128·5*	*113·1*	*115·2*	*105·7*
July, 1936 ...	*89·9*	*95·5*	*93·6*	*97·4*	*93·5*	*98·8*	*96·9*

The figures for certain of the other British index numbers of wholesale prices and the official index numbers for Germany, France and the United States are given below for comparison :—

Date	Board of Trade (1930 = 100)	*Economist* (1927 = 100)	*Statist* (1866–77 = 100)	*The Times* (1913 = 100)	France (*Stat. Générale*) (1913 = 100).	Germany (*Stat. Reichsamt*) (1913 = 100)	United States (Bureau of Labour) (1926 = 100)
May, 1938	102·0	72·2	91·4	116·0	654	105·4	78·1
June, ,,	100·7	72·0	91·4	117·2	660	105·6	78·3
July, ,,	100·6	72·2	91·1	115·6	652	—	78·5 *
July, 1937	*111·5*	*84·7*	*105·9*	*131·8*	*582*	*106·4*	*87·9*

Mean of weekly figures.

According to the index number of the Ministry of Labour for *retail prices* of articles of working-class consumption there was on balance a slight rise in general food prices during June and July 1938. The index number for food prices had fallen fairly continuously from 146 at the beginning of November 1937 to 138 at June 1st, 1938. By the beginning of July the number had risen to 146, owing chiefly to the increased prices of milk and potatoes consequent on the drought. At the middle of each year also there is always a temporary rise in potato prices owing to the change over from the old to the new crop. This year the rise was accentuated owing to the occurrence of drought and late frosts, but by the beginning of August prices had been resettled and were but slightly in advance of those at the beginning of June. The index number at the former date consequently receded to 141, as, apart from slight changes in the prices of bacon and mutton, there was no other alteration in food prices. The index numbers for rent, fuel and clothing showed no change during the period, and the index numbers for all articles, which had risen from 155 at June 1st, 1938, to 159 in July, was back to 156 at the beginning of August, or only one point above the figure twelve months earlier.

The Ministry of Labour's index numbers for recent months are given below (prices at July 1914 = 100).

	June 1st, 1938	July 1st, 1938	Aug. 1st, 1938	Aug. 1st, 1937	Aug. 1st, 1936
Food Prices	138	146	141	140	129
All Items (food, clothing, fuel, rents, etc.)	155	159	156	155	146
All Items (a year earlier) ...	152	155	155	146	143

The latest information as to the *distribution of agricultural land and the numbers of livestock in England and Wales* is contained in the summary issued by the Ministry of Agriculture of the Returns made on June 4th last by occupiers of agricultural holdings exceeding one acre. This shows that the area of cultivated land—that is, land devoted to crops of all kinds, including clover and rotation grasses and permanent grass—in 1938 amounted to 24,695,000 acres, a decrease of 85,000 acres as compared with last year. A deline in this area is an annual feature of the Returns, and is a natural result of building activity and other non-agricultural development. The decrease this year does not differ much from the normal, the decline in the last 10 years having averaged 81,000 acres per annum. In addition to the area returned as under crops and grass, there are 5,433,000 acres of mountain, heath, moor, down and other rough land used for grazing, but not classified as permanent pasture.

The above area of 24,695,000 acres comprises 8,872,000 acres of arable and 15,823,000 acres of permanent pasture. The arable area has been diminishing for many years, and shows a further decrease of 152,000 acres compared with 1937. The loss over 10 years amounts to 1,236,000 acres. Permanent pasture, on the other hand, has increased in the same period by 427,000 acres, but the total this year is lower than the area recorded in 1932 and 1933. The influence of the wheat, barley and oats subsidies is shown in an extension of the area devoted to each of these crops, the wheat area, in particular, at 1,829,000 acres, being the largest recorded since 1922.

The total number of *cattle* increased on the year by 39,000 to 6,658,000, or practically the same as the maximum of 6,660,000 recorded in 1934, and above the average of the past 10 years. This is worth noting in view of statements sometimes made to the effect that the land of this country is under-stocked. As a matter of fact, the number of cattle proportionately to the total area is higher than in any previous year, being 269 per 1,000 acres of crops and grass. Ten years ago, in 1928, it was 236.

Sheep increased by 374,000 to 17,568,000, but this figure, though above the totals for the past four years and above the ten-year average, was not up to the numbers reached in the years 1931–33.

Pigs declined by 86,000 to 3,548,000, a figure which is below the total for the past three years, though it compares favourably with the ten year average of 3,125,000. The number of pigs in this country has always been subject to wide variation from time to time.

The returns also include particulars as to the total number of agricultural workers, both male and female (including casual workers), actually in employment on June 4th. As is well known, the numbers have been decreasing for some years, and there was in 1938 a further somewhat marked reduction of 42,000, which brought the total down to 589,000. It is thought possible that some part of this decline may be due to the fact that the date of the returns happened to coincide with the termination of the yearly and half-yearly hirings, with the result that some workers may have been omitted owing to a change of employers. This would mainly apply to the regular male workers whose numbers fell from 489,800 to 469,000, or by 4·2 per cent. Proportionately, however, to their numbers the greatest reductions occurred among the casual male workers, women and girls. The present figure of 589,000, the total of all classes, compares with 772,000 in 1928, the reduction in the ten years having been 183,000 or over 23 per cent. In the same period, the regular male workers *over* 21 years old have declined from 454,000 to 379,000, or by 16 per cent., while the youths and boys classed as regular male workers *under* 21 years have decreased from 129,000 in 1928 to 89,600, or by 31 per cent. The casual youths and boys are also much less numerous, the fall in this category being 46 per cent.

The result of recent enquiries into the output of glass-house produce, fruit, and milk and milk products has led the Ministry of Agriculture to recalculate their annual estimates of the *value of the Agricultural output in England and Wales* (*Journal of the Ministry of Agriculture,* May 1938). These recalculations have had the effect of decreasing the previously published totals for the years 1931–32 to 1935–36 to the extent of roughly from 1 to 1½ per cent. The following table gives the revised figures, together with those for 1936–37, distinquishing the value of the output of the principal groups of commodities. This output represents the estimated sales of produce by farmers for the use of the non-farming community, together with the estimated quantity of home-grown produce consumed in farm households. The additional receipts by farmers as a result of the wheat and cattle subsidies are shown separately.

Millions of £.

	1930–31	1931–32	1932–33	1933–34	1934–35	1935–36	1936–37
Livestock and Livestock Products..	142·3	126·3	128·3	135·9	138·2	141·4	148·3
Farm Crops ...	33·2	33·0	26·4	30·4	35·9	36·0	39·8
Fruit and Vegetables	20·1	20·7	20·0	25·0	23·8	20·0	23·7
Glass-house Produce	7·1	7·0	7·8	7·7	8·1	8·5	8·8
Total ...	202·7	187·0	182·5	199·0	206·0	205·9	220·6
Wheat and Cattle Subsidies ...	—	—	4·3	6·7	8·3	7·9	4·1
Total ...	202·7	187·0	186·8	205·7	214·3	213·8	224·7

Compared with the very low years of 1931–32 and 1932–33, the improvement in the aggregate has been very substantial, particularly in the latest year, with the result that the total for 1936–37, including the subsidies, is larger than in any year since 1924–25, when the output value was estimated at £235 million. It will be seen that about two-thirds of the total receipts of farming are derived from livestock, milk and dairy produce, poultry, eggs and wool.

The changes shown (excluding the changes in the subsidies) are the result of variations both in quantity and price. In order to obtain an approximate indication of the alteration in the *volume* of production, the output (excluding glass-house produce) in each of the years subsequent to 1930–31 has been revalued at the prices ruling in that year; the result expressed in index numbers is as follows:—

	1930–31	1931–32	1932–33	1933–34	1934–35	1935–36	1936–37
Livestock and Livestock Products...	00	104	111	114	115	119	117
Farm Crops ...	100	85	100	110	118	105	102
Fruit and Vegetables	100	94	98	109	140	77	138
Total ...	100	100	107	113	118	112	117

The livestock group shows a comparatively steady increase over the seven years, whereas there is considerable variation in the farm crop and fruit and vegetable groups, which are appreciably influenced by weather conditions.

There was very little change in *employment* during June and July 1938, a slight increase in the numbers on the registers of the Employment Exchanges and a slight increase in the percentage unemployed in the insured trades at the middle of June being almost counterbalanced by an improvement at the middle of July. In years of fairly good employment the improvement during the two months is more considerable. The percentage unemployed in the insured trades in Great Britain and Northern Ireland (excluding agriculture), which had fallen slowly from 13·3 at the middle of January 1938 to 12·9 at the beginning of April, rose to 13·0 in May and 13·4 in June, and at the middle of July receded to 13·3. There was a seasonal increase in unemployment in coal-mining, and employment in most of the metal trades and in shipbuilding declined, and there was some falling off in building and public-works contracting. In the textile trades there was some slight improvement in the cotton and jute industries, although employment was still very poor. In the woollen and linen trades, however, unemployment increased, and in the latter was as high as 50 per cent. at the middle of July. The tinplate industry was very depressed, with over 40 per cent. of its workpeople unemployed. In industries and trades covering about two and a half million employees the rate of unemployment ranges from 20 to 50 per cent. There was no industry of any considerable size except shipbuilding in which employment was as good as it was twelve months ago.

The proportion unemployed among insured persons employed in *agriculture* in Great Britain and Northern Ireland fell from 6·6 per cent. at the middle of May to 5·3 per cent. in June and 4·5 per cent. at the middle of July. The decline is, of course, a seasonal one, and the rate of unemployment compares unfavourably with that for July 1937, when it was only 2·6 per cent. The proportion of women workers unemployed was 7·1 per cent. and of males 4·3 per cent.

Unemployment in July 1938 was lowest in London and South-Eastern and South-Western England (7·6, 6·7 and 7·2 per cent. respectively) and highest in Wales (24·7 per cent.) and in Northern Ireland (33·0 per cent.). In the Midlands it was 11·6 per cent., and in the North-Eastern, North-Western, Northern and Scotland districts it was 14·8, 17·7, 19·7 and 16·6 per cent. respectively. Unemployment in Northern Ireland is due principally to the large numbers out of work in the linen, clothing and building trades, but in agriculture also the rate of unemployment in July (16·6 per cent.) is more than three times as great as the rate in Great Britain (4·5 per cent.).

The numbers of workpeople aged 14 to 64 (insured and uninsured) on the registers of the employment exchanges and offices of the Ministry of Labour in Great Britain are given below for the latest three months.

Date	Wholly Unemployed	Temporarily Stopped	Persons Normally in Casual Employment	Total
May 16, 1938 ...	1,314,118	397,529	67,158	1,778,805
June 13, „ ...	1,268,586	468,756	65,590	1,802,912
July 18, „ ...	1,244,461	467,773	60,882	1,773,116
July 26, 1937 ...	*1,097,343*†*	*227,773**	—	*1,325,116**
July 20, 1936 ...	*1,285,805*	*296,007*	*70,260*	*1,652,072*

* Revised figures. † Includes those in casual employment.

Births.—From the Quarterly Returns of the Registrar-General published in respect of the first and second quarters of 1938, the live births registered in England and Wales during the six months, January to June 1938, are provisionally recorded as numbering 319,526, a figure more than 10,000 in excess of the number registered in the corresponding period of last year, which in its turn was 3,500 greater than those of the preceding year. The number is equivalent to an annual rate of 15·5 per thousand population operative through the half-year, and may be compared with 15·1, 15·0, 14·9 and 15·1, the similarly calculated rates for the corresponding first halves of the years 1931–34.

The current half-year's increase is not large in itself, but it is greater than any similar increase recorded for a long time, and may perhaps be credited with a little added significance, since, unlike some of the recent changes which have been observed, it is not obviously associated with preceding variations in the marriage rate, the latter having been practically stationary over the years 1936 and 1937. At the same time, the whole of the increase occurred in the earliest months of the year, and present inferences do not suggest any immediate or radical departure from the general trend exhibited by the movements of recent years.

In view of the public interest attaching to the birth-rate at the present time, it is pertinent to note that the present level is higher than that of any year since 1932, and that such changes as the figures indicate, slight though they are, have been in an upward rather than a downward direction over the past three years, a feature which has not been paralleled during the whole of the long preceding period of decline.

Marriages in the first half of 1938 are reported as numbering 153,691, corresponding to an annual rate of 14·9 persons married per 1,000 population for the half-year. The rate compares with the similarly calculated figures of 14·6, 14·7, 14·7 and 14·2 per 1,000 for the corresponding halves of the years 1931–34 respectively, and thus registers a further advance beyond the comparatively high level recently attained.

Deaths in England and Wales registered during the first two quarters of 1938 numbered 257,103, a figure 25,000 less than the corresponding figure of last year, and 16,000 less than that of the previous year. In relation to the population exposed to risk, the number corresponds to a crude annual death-rate of 12·5 per 1,000 and compares with 13·8, 13·4, 12·5 and 13·1 for the first halves of the years 1931–34. From the fact that in recent years the bulk of the variations in the year's deaths are found to be associated with fluctuations in the first quarter's figures, it is anticipated that the incidents of deaths in 1938 as a whole will be below, rather than above, the average of recent years.

A considerable improvement, both in revenue and operating results, is shown by the "Railway Returns for 1937," recently issued by the Ministry of Transport. Net revenue increased by 5·90 per cent. to £38,684,383, giving an average return upon capital issued of 3·39 per cent., as compared with 3·23 per cent. in 1936. The average return on ordinary stock issued was 1·79 per cent., against 1·44. On this class of stock actually receiving a return, the average remuneration was 2·53 per cent., the £78 million ordinary stock of the London and North-Eastern Company having passed a dividend for the seventh year in succession.

Capital outlay had reached £1,190,372,259 by the end of the year, having increased by £6,329,721. Capital receipts up to 31st December stood at £1,116,553,733, leaving an excess expenditure of £73,818,526 covered by internal investment of various reserve funds.

Gross receipts from all services, at £195,427,770, reached the highest level since 1930, and increased by £8,958,003 or 4·80 per cent. Receipts from railway working rose by £7,408,121 or 4·52 per cent. to £171,391,608. The auxiliary services contributed

£24,036,162, as compared with £22,486,280 in 1936, steam-boats, docks, hotels and refreshment-rooms and collection and delivery services each showing a marked improvement. Passenger and Parcels traffic increased by £3,029,544 or 4·20 per cent. to £75,217,025, whilst goods and miscellaneous services realized £96,174,583 or £4,378,577 (4·77 per cent.) more than in 1936. The number of passenger journeys was 3·05 per cent. higher at 1295 million, having exceeded the peak figure of 1929 by 2·68 per cent. In addition, approximately 524 million journeys originated on the London Passenger Transport Board's lines, against 488 million in 1936. About 86 per cent. of the journeys and 85 per cent. of the receipts were in respect of fares below the standard or ordinary rates, the average receipts per passenger journey being 1*s.* 5·04*d.*, compared with 1*s.* 4·64*d.* in 1936. Goods tonnage increased by 16,439,430 or 5·86 per cent. to 297,151,524, but was still some 10 per cent. below 1929.

Total expenditure increased by £6,783,338 or 4·46 per cent. to £158,966,183, of which railway working absorbed £136,135,587 and subsidiary services £22,830,596, representing increases of 4·26 and 5·64 per cent. respectively. The higher costs were chiefly in respect of salaries and wages and fuel for steam trains, but there was a slight fall in the percentage of railway working expenditure to receipts from 79·62 to 79·43, the lowest figure since 1929.

The mileage of line open for traffic at 31st December was 20,080, and there were 19,750 steam locomotives, a decrease of 224. The popularity of rail motor services is indicated by an increase in the stock of these vehicles from 1,637 to 1,874. Passenger carrying vehicles increased by 120 to 43,682, with a slight increase in average seating capacity from 58·14 to 58·40. The stock of railway-owned merchandise and mineral wagons was 20,888 larger at 656,834, the average tonnage capacity rising from 11·83 to 11·93. A census of private owners' wagons taken in July 1937 showed that there were 637,670 of these vehicles operating on the railways of Great Britain, 10,926 having been registered during 1937. The success of the road-rail container is shown by the fact that the stock of these, at 13,845, has almost doubled during the past six years.

The total mileage worked by locomotives, at 597,680,081, constituted a record for British railways, having risen by 2·23 per cent. above the 1936 figure. A new high level was also reached in the daily average mileage per locomotive in use, this figure, at 112·09, comparing with 111·55 in 1936. Steam locomotives consumed 13,035,160 tons of coal and 34,862,276 pints of lubricating oil, averaging 53·01 lb. of coal per engine mile and 6·32 pints of oil per 100 miles. Coaching train-miles per train-hour were practically unchanged at 14·97, whilst the corresponding figure for freight trains fell from 8·86 to 8·61. This was, however, accompanied by a heavier average train load, which, at 131·13 tons compared with 128·08 tons in 1936, and the net ton-miles worked per engine-hour rose from 459·69 to 465·61.

The favourable trend of 1937 appeared to be continuing during the early part of the current year, but there has been a persistent decline in traffic since the end of March. Appearing first in merchandise and coal earnings, this has now spread to passenger receipts, which have, however, to be compared with the heavy Coronation traffics of last year. By the end of June, the four main-line companies had suffered a fall in net revenue estimated at £4,668,000, due to the drop in traffic accompanied by higher salaries and wages bills, rising costs of materials and fuel and additional maintenance charges.

The Companies' returns of gross receipts up to 4th September are as follows :—

Company	Receipts £	Decrease on 1937	
		£	Per Cent.
G.W.	18,049,000	728,000	4·20
L.M.S.	43,131,000	1,543,000	3·71
L.N.E.	31,296,000	1,251,000	4·16
Southern	14,920,000	181,000	1·23
Total	107,396,000	3,703,000 *	3·57

	£
* Passenger Traffic	257,000
Merchandise Traffic	2,663,000
Coal and Coke	783,000

2. Other Statistics.

With the exception of a slight increase in rates in May, *tramp shipping freights* have continued to fall steadily throughout 1938. The revised index number of the Chamber of Shipping * (1935 = 100) which stood at 141·0 in December 1937, had fallen to 126·9 by April 1938. A rise to 130·6 took place in May, but in June and July the number again fell, and for July was as low as 120·2, or more than 14 per cent. lower than in December 1937 and nearly 32 per cent. below the average rate for 1937 as a whole. One of the principal causes of the continued depression in rates is the small amount of chartering done in the usually busy Argentine trade, and the decreased shipments of coal.

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* See Part I of the *J.R.S.S.*, 1938, pp. 53–146.

Statistics of *retail sales* prepared by the Bank of England in conjunction with various retail distributors' associations show that, taking the five months February to June 1938, there was a rise of 5·1 per cent. in the value of sales of food and perishables and a small decline (0·7 per cent.) in those of other merchandise compared with the corresponding period in 1937. There was a decline in sales in Central and West-End London of 7·6 per cent. compared with 1937, but an increase in the six other areas. It was highest (4·8 per cent.) in Southern England and lowest in the North-West area (1·9 per cent.). The index number of retail sales, which is based on the average daily sales in 1933, fell from 132 in April 1938 to 126 in May, but rose again in June to 130, the average for the five months in 1938 being 124·6, compared with 121·1 in the corresponding period of 1937.

The *International Year Book of Agricultural Statistics* for 1937–38 issued by the International Institute of Agriculture, follows the same plan as in past years, and gives in summary form statistics of crops and livestock, of international trade in agricultural products, and of prices for all countries of the world, so far as they are available.

One group of tables which may be mentioned brings together the index numbers of prices of agricultural interest published by different countries. As these indices are constructed in the various countries by different methods, they do not lend themselves very well to international comparison, but the figures of a few leading are of interest. In the United States, the agricultural produce index (base 1909–13 = 100) has risen from 65 in 1932 to 121 in 1937, while the corresponding index of goods purchased by the farmer has moved from 107 to 130. The original conception underlying these two indices was that they would provide a means of comparing the level of receipts and expenditure on typical farms, and thus afford an indication of prosperity corresponding to what prevailed in the base year. The divergence between them which subsequently occurred was regarded as indicating the fall in what was called the "purchasing power of the farmer's dollar," and provided a powerful argument in support of farmers' claims for special treatment. As will be seen, the difference in 1937 was much less than in 1932, although the index of goods purchased was still above the level of the index of goods sold.

Canada and Argentina both adopt the same base year (1926 = 100) and, like the United States, show an appreciable rise, the former from 48·4 in 1932 to 87·0 in 1937, and the latter from 59·1 to 104·5 in the same years. It is interesting to notice that if the index numbers for these countries and for the United States are all converted to a uniform base, the movement between 1932 and 1937 was somewhat similar, owing no doubt to the fact that their agricultural prices are more or less in competition. In Germany and Italy, where prices are more a question of internal trade, the movement has been much less, the figures in Germany (1909–13 = 100) being from 89 in 1932 to 100 in 1937 and in Italy (1928 = 100) from 65 in 1932 to 83·8 in 1937.

According to reports from the International Institute of Agriculture, the aggregate *wheat crop* of the Northern Hemisphere (chiefly Europe and North America) is expected to be exceptionally large; preliminary estimates at 3,860 million bushels, as compared with 3,369 million bushels in 1937, show an increase of 13 per cent. on last year and of 20 per cent. on the average of 1932–36. If these estimates are confirmed, this year's yield will constitute an absolute record. Given average production in the Southern Hemisphere (chiefly Argentina and Australia), the total quantity of wheat available for export from all sources in the 1938–39 season is likely to be almost double the requirements of importing countries, and the stocks which in August 1938 were about normal are again likely to be greatly enlarged, with the risk of a return to the difficult situation which was created in recent years by the existence of excessive surplus stocks. As a consequence, there has been a sharp fall in prices, particularly in futures. Although the output is, no doubt, mainly due to satisfactory weather conditions, there are indications of an expansion in the area sown over the total for 1937 which was one of the highest on record.

In the paper on Scandinavian statistics read before the Society in February of last year, it was stated that details of the import trade of Sweden, grouped by the countries in which the goods concerned were produced, were to be prepared for a series of years, in addition to the details grouped by the countries in which the goods were purchased, the basis of the classification in the official accounts for 1935 and the thirty preceding years. The primary classification for 1936, as shown in the accounts for that year, is based on countries of production, and particulars on that basis for 1935 have now been published in a volume, bearing the title *Transithandeln*, prepared by a member of the staff of the Swedish Board of Trade, Dr. Sven K. Stockman. An introduction to the tabular matter, in which the two bases of presentation of the figures are compared, contains a description of the steps taken to secure the supplementary information for 1935, and an analysis of the leading results obtained.

Goods bought in a country other than that in which they were produced are described as reaching Sweden in transit via the country of purchase. Doubtless much, if not most, of the trade thus described as passing commercially via the country of purchase passes also physically by way of that country. It is, however, by no means necessarily the case that it should do so, since merchants (in Germany, for example) could quite well supply, for delivery in Sweden, goods purchased by their agents in other countries, including the countries of actual production, and cause them to be shipped from those countries, whether the route followed passed through the country officially recorded as the country of purchase or not. It may be, for example, that the considerable purchases of Australian and New Zealand wool made in the Netherlands may, in part, have passed via the London market and been shipped from the Thames direct to Swedish ports. The problem of indirect trade has, however, as Dr. Stockman justly points out, an importance from the side of the route by which payment is effected, as well as that of the route by which the goods may be conveyed, and that importance is not decreased by the extensions of the practice of foreign exchange control.

In view of the importance of British re-export trade, and of transhipment in bond in British ports, it is no matter of surprise that the record by countries of production assigns a smaller proportion (14·06 per cent. in 1935 and 13·49 per cent. in 1936) of imports into Sweden to trade with Great Britain than the previous basis of record by countries of purchase (19·24 per cent. in 1935 and 19·16 per cent. in 1936). In the case of imports from Germany, representing, on the "country-of-purchase" basis, somewhat over 24 per cent. in both years, there is a reduction by about one-tenth when the basis of record is the country of "production." The figures representing the U.S.A. share in Swedish imports are surprisingly little affected: they are 12·79 and 13·66 per cent. on the "purchase" basis, and 12·92 per cent. for both years on the "production" basis. After these three major sources, Denmark follows next in order, with a larger relative reduction in passing from the "purchase" to the "production" basis than any of these three—namely, from 6·50 to 3·73 per cent. in 1935 and from 6·16 to 3·53 per cent. in 1936.

Of the 2,010 headings distinguished in the Swedish import returns, no indirect trade was recorded for 1935 under 543 headings. These headings covered, however, only about one-thirtieth part of the total value of goods imported. For a further 1,342 headings, the indirect trade was less then 4 per cent. of the total imports of the goods concerned, which did not reach £13,000 for any of the headings.

If we include a further 84 headings under which imports in 1935 were recorded at less than a million Kronor (roughly £50,000), the indirect trade in which totalled rather less than one-seventh of the imports of such goods from all sources, there remains 70 per cent. of the indirect trade distributed among 41 headings (including six of the seven headings for mineral oils) under which approximately one-quarter of the aggregate imports were recorded. For these the indirect trade amounted in all to about 47 per cent. of the total imports. The analysis contains much that is of interest in relation to the commodities that figure prominently in the import trade of Sweden, but it brings out the relatively limited range of articles that contribute in an important degree to the indirect trade.

CURRENT NOTES

During the past 13 years an Advisory Committee of the United States Social Science Research Council has issued 21 valuable reports on various aspects of agricultural research. The Committee has now concluded the series with a Report on "Research in Agricultural Index Numbers" prepared by Professors John D. Black and Bruce D. Mudgett under the direction of the Advisory Committee (Social Science Research Council, New York City, 1938. viii + 152 pages. 75 cents.). This report, No. 10 of the series, has been in preparation for eight years. To English readers the publication is very timely, coming as it does when the Ministry of Agriculture has just published an account of the recent revision of the Agricultural Price Index Number for England and Wales.

After a short account of the development of farm price index numbers, the Report devotes 75 pages to a discussion of the relevant index-number theories, 56 pages to an account of existing index series in the States and concludes with a section on research relating to index numbers. Professors Black and Mudgett are responsible for much of the material and for the arrangement and continuity, but a special Committee appointed to consider the Report comprised such well-known names as those of Profe[illegible] Irving Fisher, W. I. King, F. C. Mills, Murray R. Benedic[illegible] the late Professor Warren M. Persons and Dr. Stine of the United States Department of Agriculture. The views of all these gentlemen and several of their colleagues are incorporated in the Report, which can thus claim to be an authoritative account of the subject. Professor Black has laboured with success to describe the viewpoints of the different contributors, and has performed the difficult feat of dealing justly and concisely with the various conflicting opinions. As a result the Report is a valuable document both for instruction and for reference.

A short treatise (164 pages) on Rudimentary Mathematics for Economists and Statisticians, by W. L. Crum, has been published by the *Quarterly Journal of Economics* as the first of a series of special Supplements which are intended to appear at intervals of about a year. The material is divided into Graphic Analysis (Chapters I and II), Limits, Rules and Derivatives, Maxima and Minima treated by differential calculus methods, and the simpler type of differential equations. The work is thus a highly compressed introduction for beginners in mathematical economics. The elementary mathematics involved is throughout supplemented by examples drawn from economic and statistical theory, and for each equation a curve is drawn.

The Leonard Darwin Research Fellowship offered by the Eugenics Society for 1938 has been awarded to Dr. Dora Ilse, who proposes to carry out a research into a Genetical Analysis of psychological or physiological characters, with special reference to twins, at the University of Edinburgh under Professor Crew.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

UNITED KINGDOM—

The Banker—

August, 1938—The banks and industry: *A. T. K. Grant.* The Austrian banking changes: *W. G. L. Knop.* Silver bullets: *Paul Einzig.*

September, 1938—Germany's financial crisis: *W. G. L. Knop.* Irish banking: articles by *John P. Colbert*, *Joseph Johnston* and *W. W. Syrett.* Credit control in Australia: *W. T. C. King.*

Bankers' Magazine, *September*, 1938—No evidence of a cycle in trade conditions: *A. H. Gibson.* Assets structure of joint-stock banking: a correspondent. Cheap money—its advantages and disadvantages: *John Brunton.*

Economica, *August*, 1938—Assets, prices and monetary theory: *H. Makower* and *J. Marschak.* The analysis of vital statistics: II, Birth and death statistics: *R. R. Kuczynski.* Live and dead issues in the methodology of economics: *Lionel Robbins.*

Eugenics Review, *July*, 1938—Population policies in Scandinavia: *D. V. Glass.* Measurement of differential reproduction: *Christopher Tietze.* Fertility and economic status in London: *D. V. Glass.*

Faculty of Actuaries, *Transactions*, *Vol. XVI*, *Part VIII*—Presentation of Gold Medal to William Palin Elderton, C.B.E., F.I.A., F.F.A.

Royal Philosophical Society of Glasgow, *Proceedings*, *Vol. LXIII*—Health policy of the future: *E. P. Cathcart.* The re-organization of the iron and steel industry: *the Rt. Hon. the Earl of Dudley.* Recent experiments in land reclamation in Scotland: *W. G. Ogg.* Working-class housing in Scotland—to-day and to-morrow: *J. E. Highton.* Problems relating to safety and health in coal mines: *Andrew Bryan.* Trends in economic and social policy: *Harold Macmillan.*

Sociological Review, *July*, 1938—Childless marriages: *R. R. Kuczynski.* The social consequences of industrial transference: a reply: *Michael Daly.* Social origins of a sample of entrants to Glasgow University, Part II: *Adam Collier.* The time-lag in the recent migration movements within Great Britain: *R. S. Walshaw.*

AUSTRALIA—

Economic Record, *June*, 1938—Towards industrial peace in Australia (review article): *N. Cowper.* British migration to Australia—demographic and social aspects: *W. D. Forsyth.* The basic wage in Australia: *G. Anderson.* National income and company profits in Australia: *Margaret Rylah.*

UNION OF SOUTH AFRICA—

South African Journal of Economics, June, 1938—Economic aspects of the Cape Coloured Commission: *Professor W. H. Hutt.* International trade, with special reference to the British Commonwealth and the U.S.A.: *Professor H. R. Burrows.* The hides and skins industry in South Africa: need for research: *S. G. Shuttleworth.*

UNITED STATES—

Annals of Mathematical Statistics, June, 1938—Tests of statistical hypotheses which are unbiased in the limit: *J. Neyman.* The transformation of statistics to simplify their distribution: *Harold Hotelling* and *L. R. Frankel.*

Econometrica, July, 1938—The method of supplementary confluent relations, illustrated by a study of stock prices: *Trygve Haavelmo.* Annual survey of economic theory: the theory of depreciation: *Gabriel A. D. Preinreich.* The general welfare in relation to problems of taxation and of railway and utility rates: *Harold Hotelling.* Differential effect in the butter market: *Irma Hilfer.*

Journal of Political Economy, August, 1938—Recent and contemporary theories of progressive taxation: *Elmer Fagan.* The German use of unemployment-insurance funds for works purposes: *E. B. Mittelman.*

Milbank Memorial Fund Quarterly, July, 1938—Four years of district health administration in New York City: *John L. Rice* and *Margaret W. Barnard.* The dental problem of elementary school children: *Henry Klein* and *Carroll E. Palmer.* Social and economic problems in the control of tuberculosis: *Bailey B. Burritt.*

Quarterly Journal of Economics, August, 1938—The distribution of income among income taxpayers in the United States, 1863–1935: *Rufus S. Tucker.* The outcome of the saving–investment discussion: *F. A. Lutz.* The Canadian baking industry: a study of an imperfect market: *Lloyd G. Reynolds.*

DENMARK—

Nationaløkonomisk Tidsskrift, Hefte 3, 1938—Reklame for Parlamentsstyret: *Theodor Geiger.* En Empirisk Prisanalyse. Engrospriserne 1855-1913: *H. Winding Pedersen.*

FRANCE—

Revue d'Économie Politique, Mai-Juin, 1938—La France Économique, annuaire pour 1937. [Whole number.]

GERMANY—

Allgemeines Statistisches Archiv, Heft 1, 1938—Grossdeutschland und die Statistik: *Adolf Gunther.* Die Gliederung nach Stadt und Land in der Statistik: *Kurt Horstmann.* Die Sterblichkeit der Brust- und Flaschenkinder: *Ernst Meier* and *Du Dscheng Hsing.* Lochkartenmaschinen im Dienste der Reichsstatistik: Verwaltungs-Amtmann *Biehler.*

GERMANY—*Contd.*

Weltwirtschaftliches Archiv, Juli, 1938—Das Ringen um die Erneuerung der aussenwirtschaftlichen Theorie in Deutschland: *Erich Egner.* Wo gilt das Theorem der komparativen Kosten? *August Lösch.*

HUNGARY—

Journal de la Société Hongroise de Statistique, N. 2–3, 1938—Un index d'immunité criminelle relative: *B. Földes.* Le système de la statistique intellectuelle: *D. Elekes.* Développement de la population italienne de 1931 à 1936: *M. de Vergottini.* Les rapports entre les professions et la fécondité des mariages d'après une statistique hongroise: *L. Thirring.* Corrélations des phénomènes démographiques à plusieurs variables, représentables géométriquement dans l'espace: *Theodore Szél.* La corrélation statistique et la loi de la demande: *E. Theiss.* Mouvement de la population et conjonctures: *É. Varga.*

ITALY—

Annali di Economia, Vol. XIII, N. 1—La "response" al Malestroit e il pensiero economico di Jean Bodin: *Edilio Chiriotti.*

Le Assicurazioni Sociali, Marz-Aprile, 1938—Indici di morbilità nei lavoratori commerciali: *Gino Bizzarri.* [A Supplement contains this article in French.]

Economia—

Giugno, 1938—La fluttuazione settimanale delle nascite: *Livio Livi.* Sulle tavole di mortalità per stato civile con speciale riguardo a quelle italiane 1930–32: *Giuseppe Parenti.*

Luglio, 1938—L'aborto nel quadro della denatalità: divagazioni statistiche: *Piero Pagani.*

Giornale degli Economisti e Rivista di Statistica, Luglio, 1938—Cambiamenti di sistemi di politica economica: *Francesco Vito.* Tendenze autarchiche negli spostamenti internazionali della produzione delle materie prime: *Giorgio Mortara.* Ancora su due recenti tavole di nuzialità della popolazione italiana: *Giuseppe Parenti.*

SWITZERLAND—

Journal de Statistique et Revue Economique Suisse—

I, 1938—Der schweizerische Handel auf Grund der Betriebszählung von 1929. (IV, Schluss): vom Eidgenössischen Statistischen Amt, Bern. Milchproduktion und Milchverwertung in der Schweiz, 1926–1935: *J. Käch.*

II, 1938—Die Überalterung der schweizerischen Bevölkerung: *W. Bickel.* Der Geburtenrückgang als nationales Problem: *Philipp Etter.* Vorausberechnung der schweizerischen Bevölkerung bis Ende 1960: vom Eidgenössischen Statistischen Amt, Bern.

INTERNATIONAL—

International Labour Review—

June, 1938—The first session of the Permanent Agricultural Committee. The co-operative society as an instrument of economic and social construction: *C. F. Strickland.*

July, 1938—Introduction to the financial problems of social insurance: *Lucien Féraud.*

August, 1938—The Chilean Preventive Medicine Act: *Eduardo Cruz Coke L.* Maritime labour in the United States: *Elmo Paul Hohman.*

Revue de l'Institut International de Statistique, Livr. 2, 1938—La mortalité par cancer aux Pays-Bas: *C. A. Verrijn Stuart.* Rapport de la commission pour la définition de la " population rurale ": *H. Bunle.* The statistical measurement of changes in national productive equipment: *Sir Alfred W. Flux.* Directives pour l'élaboration des statistiques de la radiodiffusion dans les divers pays: *Ph. J. Idenburg.* Les bases de comparaison du nombre des accidents de la circulation routière: *J. H. van Zanten.* Die Abgrenzung statistischer Gruppen: *K. Drexel.* Statistik als Hilfsmittel der medizinischen Forschung. Mit einem Beitrag über " Statistik der Kreislaufkrankheiten " von Dr. Boehm: *E. F. Wagemann.*

LIST OF ADDITIONS TO THE LIBRARY.

Since the issue of Part III, 1938, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS.

(a) **United Kingdom.**

Colonial Office—

Economic survey of the Colonial Empire (1936). 13″ × 8¼″. vi + 639 pp. 27*s.*

Trinidad and Tobago disturbances, 1937. Report of Commission. Cmd. 5641. 9¾″ × 6″. 120 pp. 2*s.* [London : H.M.S.O., 1938.]

General Register Office, Northern Ireland. Census of population 1937. Belfast County Borough, Belfast : H.M.S.O., 1938. 13¼″ × 8¼″. xxiv + 31 pp. 2*s.* 6*d.*

Health, Ministry of. Reports on public health and medical subjects : 84. On the provision and distribution of infective material for the practice of malaria-therapy in England and Wales. 21 pp. 6*d.* 85. On the longevity of mosquitoes in relation to the transmission of malaria in nature. 45 pp. 9*d.* London : H.M.S.O., 1938. 9¾″ × 6″.

Imperial Economic Committee—

Apples and pears : a survey of production and trade in the British Empire and foreign countries. 275 pp. 4*s.*

Dairy produce supplies 1937 : including poultry and pig products. . . . 13¼″ × 8¼″. 123 pp. 2*s.* 6*d.* [London : H.M.S.O., 1938.]

Permanent Consultative Committee on Official Statistics. Guide to current official statistics of the United Kingdom. Vol. 16. 1937. London : H.M.S.O., 1938. 9¾″ × 6″. 406 pp. 1*s.*

H.M. Stationery Office. Brief guide to government publications. By *F. R. Cowell.* London : H.M.S.O., 1938. 8½″ × 5½″. 44 pp. 3*d.*

(b) **British Empire.**

India—

Hyderabad-Deccan. H.E.H. the Nizam's Government. Report on the administration of the Department of Statistics for the year 1344F. (6th October 1934 to 5th October 1935). By *Mazhar Husain*, Director. Hyderabad-Deccan : Government Central Press, 1936. 13″ × 8½″. 13 pp.

New Zealand—

Census and Statistics Department. Population 1936. Appendix B : war service. Wellington, 1938. 12¼″ × 9¾″. 11 pp.

Palestine—

Statistics, Department of. Annual report 1937. Jerusalem, 1938. 13″ × 8¼″. 102 pp. 3*s.*

(c) **Foreign Countries.**

Brazil—

Pernambuco. Directoria Geral de Estatistica—

Anuario estatistico. Ano ix, 1935–1936. Recife, 1938. 10½″ × 7″. 389 pp.

Estatisticas educacionaes (Supplemento do annuario estatistico). Annos de 1934 e 1935. Recife, 1937. 10½″ × 7″. 292 pp.

(c) **Foreign Countries**—*Contd.*

Germany—

Statistisches Reichsamt. Statistik des deutschen Reichs. Bände: 511. Umsatzsteuerstatistik 1935. II Teil. Einzelergebnisse für die Gewebeabteilung Industrie und Handwerk. 256 pp. 15 *Rm.* 516. Die deutschen Sparkassen in den Jahren 1934 bis 1937. 227 pp. 12 *Rm.*

Baden. Badisches Statistisches Landesamt. Statistisches Jahrbuch für das Land Baden. 44 Jahrgang 1938. Karlsruhe, 1938. 10¾″ × 7½″. xviii + 426 + 32 + 11 pp.

Italy—

Istituto Centrale di Statistica. VIII censimento generale della popolazione 21 aprile 1936. Vol. III. Regno, popolazione, territorio, famiglie, convivenze, sesso, stato civile, età, stranieri. Parte prima, relazione. Rome, 1938. 12″ × 9″. viii + 131 pp. *L.* 15.

Poland—

Office Central de Statistique. Deuxième recensement général de la population du 9 décembre 1931. Logements et ménages, population, professions. Fasc. 86. Voïévodie de Kielce. Fasc. 87. Voïévodie de Polesie. Warsaw, 1938. 11½″ × 8¼″. 2 parts.

Spain—

Ministerio de Agricultura, Subsecretaria. Sección de Estadistica, Economia y Politica Agraria. Publicación num. 70. Estadistica de la producción de cereales y leguminosas 1937. 69 pp.

—— 73. Estadistica de la producción vitivicola 1937. 30 pp.

—— 77. Estadistica de la producción de las praderas artificiales y forrajes 1937. 30 pp. [Barcelona, 1937. 9¾″ × 6¼″. 3 parts.]

Switzerland—

Bureau Fédéral de Statistique. Contributions à la Statistique Suisse 7. Les étudiants en Suisse. Enquête de 1936. Bern, 1938. 9¾″ × 6¾″. 103 pp.

United States—

New York State. State Tax Commission. Special report . . . No. 14. Budgetary methods in national and state governments. By *J. Wilner Sundelson.* Albany, N.Y., 1938. 9″ × 5½″. xvi + 640 pp. + 6 tables.

(d) **International.**

International Labour Office—

Studies and reports, Series B. No. 29. Problems of industry in the East: with special reference to India, French India, Ceylon, Malaya, and the Netherlands Indies. By *Harold Butler.* Geneva (London: P. S. King), 1938. 9½″ × 6¼″. 74 pp. 1*s.* 6*d.*

League of Nations—

Economic and Financial Section—

Committee of statistical experts: report to the Council on the work of the seventh session . . . July 4 to 9, 1938. 13″ × 8¼″. 28 pp.

Report on exchange control submitted by a committee composed of members of the Economic and Financial Committees. 9½″ × 6¼″. 53 pp. [Geneva (London: Allen and Unwin), 1938.]

Economic Intelligence Service. Review of world trade 1937. Geneva (London: Allen and Unwin), 1938. 10¾″ × 8¼. 95 pp. 2*s.* 6*d.*

II.—AUTHORS AND MISCELLANEOUS.

Académie des Sciences de la RSS d'Ukraine. Travaux de l'Institut de Démographie. Tome XII. Recueil de statistique sanitaire. Rédigé par *S.S.* —*Kagan*. 161 pp.

—XIII. Des méthodes pour l'étude du mouvement des maladies infectieuses. Fasc. 1. Scarlatine. 200 pp.

—— XIV. Recueil de statistique sanitaire. Rédigé par *S.S. Kagan*. 327 pp. [Kiev, 1937–38. 10½" × 6¾". 3 vols.]

Building Societies Association. Building societies year book 1938: official handbook of the . . . Association. London: Franey, 1938. 8¼" × 5¼". 526 pp. 10*s*. 6*d*.

Cowan (*Donald R. G.*). Sales analysis from the management standpoint. Chicago: University Press (London: Cambridge University Press), 1938. 9" × 6". xi + 210 pp. 9*s*.

Cowles (*Alfred*) and associates. Common-stock indexes 1871–1937. Bloomington, Indiana: Principia Press, 1938. 9¾" × 6½". xii + 499 pp. $6.

Englehart (*Max D.*). The technique of path coefficients. Reprint from *Psychometrika*, December, 1936. pp. 287–293. 10" + 6¾".

Evidences of the great age of Henry Jenkins, with notes respecting longevity and long-lived persons. . . . London: Bell and Daldy, 1859. 8½" × 5½". 32 pp. (From Mr. Yule.)

Ferenczi (*Imre*). Aliens in the world and nationals abroad. Reprint from *Social Service Review*, December, 1937. pp. 693–704. (From the author.)

—— The synthetic optimum of population: an outline of an international demographic policy. Paris: International Institute of Intellectual Cooperation, 1938. 9½" × 6". 115 pp.

Gandhi (*M. P.*). The Indian cotton textile industry (1938 annual). Calcutta: Gandhi and Co., 1938. 9¾" × 6¼". xxii + 100 + xxxviii pp. 7*s*. 6*d*.

George (*Heinz*). Kautschuk: Wandlungen in der Erzeugung und der Verwendung des Kautschuks nach dem Weltkrieg. (Wandlungen in der Weltwirtschaft, Heft 9.) Leipzig: Bibliographisches Institut AG, 1938. 9" × 6¼". x + 199 pp. 10 *Rm.*

Griziotti (*Benvenuto*). Intorno alla scuola di Luigi Cossa in Pavia. . . . Pavia: Treves, 1938. 9¾" × 6¾". 44 pp. *L.* 10.

Hempel (*Curt*). Statistische Untersuchungen über die eheliche Fruchtbarkeit: Fruchtbarkeitstafeln, nach mathematisch- statistischen Methoden aufgestellt und bevölkerungswissenschaftlich ausgewertet. Dresden: M. Dittert, 1937. 9½" × 6¼". 169 + 2 pp. *Rm.* 2.85.

Henry (*Harry*). The insurance man and his trade. London: Fact, 1938. 7" × 4½". 92 pp. 1*s*. cloth. 6*d*. paper.

Hodson (*H. V.*). Slump and recovery 1929–1937: a survey of world economic affairs. London, etc.: Oxford University Press, 1938. Issued under the auspices of the Royal Institute of International Affairs. 8½" × 5½". viii + 484 pp. 10*s*. 6*d*.

Hubbard (*Leonard E.*). Soviet trade and distribution. London: Macmillan, 1938. 8½" × 5½". xiv + 381 pp. 12*s*. 6*d*.

Hutcheson (*Harold*). Tench Coxe: a study in American economic development. Baltimore: Johns Hopkins Press (London: H. Milford), 1938. 8½" × 5½". ix + 227 pp.

International Statistical Institute. Bulletins: Tome XXVII. livr. 1. (Session de Mexico 1933). viii + 266 pp. XXVIII. livr. 1. (Session de Londres, 1934). ix + 255 pp. [The Hague: W. P. Van Stockum, 1938. 10½" × 7". *Fl.* 3.]

—— International abstract of economic statistics, 1931–1936. The Hague: W. P. Van Stockum, 1938. 11¼" × 9". viii + 249 pp. *Fl. 4.*

International Tin Research and Development Council. Statistical year book 1938. London: the Council, 1938. 10½" × 8¼". 206 pp. 6*s*.

Kelley (*Truman Lee*). The Kelley statistical tables. New York and London: Macmillan, 1938. 11" × 8½". vi + 136 pp. 20*s*.

Kendall (*M. G.*). A new measure of rank correlation. London: reprint from *Biometrika*, June 1938, pp. 81–93. 10¾" × 7¼". (From the author.)

Lescure (*Jean*). Des crises générales et périodiques de surproduction. 5th ed. Paris: Domat-Montchrestien, 1938. 9"×5½". 2 vols. 100 *fr.*

II.—Authors and Miscellaneous—*Contd.*

Lindblad (*Tord*). Zur Theorie der Korrelation bei mehrdimensionalen zufälligen Variablen. (Acta Societatis Scientiarum Fennicae A, II, No. 10.) Helsingfors, 1937. 11¼″ × 8¾″. 81 pp.

Lindquist (*E. F.*). A first course in statistics: their use and interpretation in education and psychology. 8¾″ × 5½″. xi + 226 pp. 8*s*. 6*d*.

—— Study manual for a first course in statistics. 11″ × 8″. 122 pp. 5*s*.
[Boston, Mass.: Houghton Mifflin (London: G. Harrap), 1938.]

Liverpool, University of. Report on co-operation between the Unemployment Assistance Board, the local authority, and voluntary associations in Liverpool. 9¾″ × 6″. 64 pp. 2*s*. 6*d*.

—— Social Science Department: Statistics Division. Social service: overlapping and co-ordination. An examination of the Liverpool register of mutual assistance. 8½″ × 5½″. 39 pp. 1*s*.
[Liverpool: University Press, 1938.]

Lyon, Université de. Travaux de l'Institut de Science Financière et d'Assurances: 57. Cours de statistique mathématique Vol. II. Analyse des aléatoires. *E. J. Gumbel.* 100 pp. 69. Les intervalles extrèmes entre les émissions radio-actives, I. *E. J. Gumbel.* 9 pp. 70. Généralisation de l'inégalité de Boole. *E. J. Gumbel.* 4 pp. 72. Les intervalles extrèmes entre les émissions radio-actives, II. 7 pp. *E. J. Gumbel.* 73. Bulletin de l'Association Amicale des Anciens Élèves. . . . 16 pp. 74. Calcul des probabilités: sur quelques lois d'erreurs à deux dimensions. *Henri Eyraud.* 3 pp. 75. Statistique—La prévision des inondations. *E. J. Gumbel.* 3 pp. 77. Calcul des probabilités—Sur certaines décompositions en aléatoires imaginaires. *Henri Eyraud.* 3 pp. Lyon, 1937–38. 10¾″ × 8½″.

Martin (*W. J.*) and *Cheeseman* (*E. A.*). Rural mortality: its comparative sex incidence. Reprint from *Biometrika*, June, 1938, pp. 57–64. 10¾″ × 7¾″. (From the authors.)

Mengarini (*Publio*). Formazione e trasformazione dei gusti. Rome: reprint from *Rivista de Politica Economica*, 1937. 7½″ × 5¼″. 44 pp.

Mitropolsky (*A.*). On establishing the correlation equations by Tchebychoff's method. Reprint from *Bulletin de l'Academie des Sciences de l'URSS*, 1937, pp. 125–134. [Russian text, English summary.] (From the author.)

Munro (*Hugh*). Principles of monetary-industrial stability. London and Glasgow: Blackie, 1938. 7¾″ × 5″. xiii + 130 pp. 5*s*.

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Nixon (*J. W.*). [Statistical] work of the International Labour Office. Reprint from *Journal of the Statistical and Social Inquiry Society of Ireland*, 1938, pp. 69–83, 9½″ × 6″. (From the author.)

Pietra (*G.*) Alcune lettere inedite di Léon Walras e di Angelo Messedaglia. Reprint from *Atti del Reale Istituto Veneto di Science Lettere ed Arti*, tomo XCVI, part 2, pp. 335–356. Venice, 1937. 9½″ × 6¼″. (From the author.)

Pirou (*Gaétan*). Les théories de l'équilibre économique L. Walras et V. Pareto. Conferences faites à l'École Pratique des Hautes Études en 1932–33 et 1933–34, 2nd ed. Paris: Domat-Montchrestien, 1938. 9″ × 5½″. 465 pp. 85 *f*.

Punjab, Board of Economic Inquiry. Publications: 53. Farm accounts in the Punjab, 1937. 296 pp. *Rs.* 1/8. 54. Punjab village surveys, II. An economic survey of Durrana Langana . . . 1938. 308 pp. *Rs.* 3. 55. Cost of milk production (1931–32 to 1934–35) at Lyallpur, Punjab. 1938. 77 pp. 8 *as.* 56. Urban working class cost of living index numbers (1936) in the Punjab . . . 1938. 19 pp. 8 *as.* 57. Sales of land in South-West Punjab 1931–32 to 1933–34. 1938. 51 pp. 6 *as.* Lahore: C. and M. Gazette. 9¾″ × 6½″.

Qureshi (*Anwar Iqbal*). The state and economic life: being a study of the methods of state intervention in economic life in the leading countries of the world with special reference to the problems facing India . . . with a foreword by *Vera Anstey.* Bombay: New Book Co., 1938. 8½″ × 5½″. xi + 208 pp. 7*s*. 6*d*.

Roper (*W. Crosby*). The problems of pricing in a socialist state. Cambridge, Mass.: Harvard University Press (London: H. Milford), 1938. 7¾″ × 4¾″. 71 pp.

II.—Authors and Miscellaneous—*Contd.*

Savur (*S. R.*). The use of the median in tests of significance. Reprint from the *Indian Academy of Sciences,* Vol. V, June 1937, pp. 564–576. 10″ × 7½″. (From the author.)

Schumann (*C. G. W.*). Gold und Konjunktur in Südafrika. (Kieler Vorträge. 55). Jena: G. Fischer, 1938. 9½″ × 6½″. 22 pp.

Sinha (*J. C.*). Indian currency problems in the last decade (1926–1936). Sir Kikabhai Premchand Readership lectures delivered in February 1937, at Delhi University. Delhi: the University, 1938. 9½″ × 6½″. vii + 166 pp. (From the author.)

Society of Motor Manufacturers and Traders Ltd. The motor industry of Great Britain, 1938. London: Statistical Department, Society of Motor Manufacturers . . . 1938. 9¾″ × 6″. 189 pp. *5s.*

Sofia, State University of. Publications of the Statistical Institute for Economic Research. 1937, No. 3–4. 363 pp. 1938, No. 1. 101 pp. Sofia, 1937–38. 11¼″ × 8¼″.

Souto (*J. Barral*). El modo y otras medias, casos particulares de una misma expresion matematica. Buenos Aires: Universidad Nacional, 1938. 10″ × 6½″. 18 pp.

Starodubsky (*Lev*). Das Volkszählungswesen in der Union der Sozialistischen Sowjetrepubliken: eine statistisch-methodologische Untersuchung. Leipzig and Vienna: Franz Deuticke, 1938. 8¾″ × 5¾″. 142 pp. *Rm.* 3.

Statistica . . . Memoirs of the Statistical Laboratory, Central College of Agriculture, Warsaw . . . Nr. VI. Warsaw, 1938. 11″ × 8½″. 9 papers.

Stevens (*W. L.*). The distribution of entries in a contingency table with fixed marginal totals. London: reprint from *Annals of Eugenics,* Vol. VIII, Part III, 1938, pp. 238–44. 11″ × 8″. (From the Galton Laboratory.)

Tamagnini (*Eusébio*). A heterogeneidade da variação análise da variância questões de método. Reprint from *Revista da Faculdade de Ciencias da Universidade de Coimbra,* Vol. VI, No. 4. 9½″ × 6½″. 19 pp.

"Taxation." Key to income tax surtax and national defence contribution . . . 3rd ed. London: Taxation Publishing Co., 1938. 8½″ × 5½″. 160 pp. 3*s.* 6*d.*

Wagner (*Josef*). Die Preispolitik im Vierjahresplan. (Kieler Vorträge . . . 51.) Jena: G. Fischer, 1938. 9½″ × 6¼″. 18 pp.

Wahlund (*Sten*). A new method of determining correlation from tetrachoric groupings. Uppsala: reprint from *Landbruks-Högskolans Annaler,* Vol. 2, 1935, pp. 182–242. 9¼″ × 6″.

Walras (*Auguste*). De la nature de la richesse et de l'origine de la valeur, augmenté de notes inédites de Jean-Baptiste Say suivi du mémoire sur l'origine de la valeur d'échange . . . et précédé d'une introduction biographique sur la vie et les travaux de l'auteur par *Gaston Leduc* et d'une preface de *Gaëtan Pirou.* Paris: F. Alcan, 1938. 9″ × 5½″. xv + 344 pp. *50 f.*

Walter (*Karl*). The class conflict in Italy. London: P. S. King, 1938. 8½″ × 5¼″. ix + 137 pp. 5*s.*

Weinberger (*Ottone*). Economia matematica. Napoli: I.T.E.A., 1937. 10″ × 7″. 30 pp. (From the author.)

Whitehead (*T. N.*). The industrial worker: a statistical study of human relations in a group of manual workers. By *T. N. Whitehead* . . . drawings by *Helen M. Mitchell.* Cambridge, Mass.: Harvard University Press (London: Oxford University Press), 1938. 10½″ × 7″. xiv + 265 + viii + 10 + [166] pp. 21*s.*

Wishart (*John*). Field experiments of factorial design. Reprint from *Journal of Agricultural Science,* April, 1938, pp. 299–306. 10″ × 7″.

—— Growth-rate determinations in nutrition studies with the bacon pig, and their analysis. Reprint from *Biometrika,* June, 1938, pp. 16–28. 10″ × 7″.

Yates (*F.*). The design and analysis of factorial experiments. (Technical communication No. 35.) Harpenden: Imperial Bureau of Soil Science, 1937. 9¾″ × 7¼″. 96 pp. 5*s.*

Yule (*G. Udny*). On some properties of normal distributions, univariate and bivariate, based on sums of squares of frequencies. pp. 1–10.

—— Notes of Karl Pearson's lectures on the theory of statistics 1884–96. pp. 198–203.

[Reprints from *Biometrika,* June, 1938. 11¾″ × 8½″. (From the author.)]

PERIODICALS RECEIVED BY THE LIBRARY.

ANNUAL LIST.

In addition to the publications named in the bi-monthly lists, the Society receives the official and other periodicals enumerated below.

(a) **United Kingdom and its several Divisions.**

National.

United Kingdom—

Admiralty. Health of the Navy. Fleets. Navy appropriation account. Navy dockyard accounts.

Agriculture and Fisheries, Ministry of. Agricultural market report. Agricultural marketing schemes report. Agricultural statistics. Diseases of animals, report. Economic series reports. Journal of the Ministry of Agriculture. Land Division, report. Salmon and freshwater fisheries report. Sea fisheries: report; statistical tables.

Air Ministry. Air services appropriation account. Health of the Royal Air Force. Progress of civil aviation.

Charity Commission. Report.

Civil Service Commission. Annual report.

Colonial Office. Annual Colonial reports. Economic survey of the Colonial Empire.

Control, Board of. Lunacy and mental deficiency.

Crown Lands, Office of Commissioners of. Report.

Customs and Excise, Board of. Customs and excise tariff of the United Kingdom, report of the Commissioners.

Development Commission. Report.

Dominions Office. Report of Oversea Settlement Board.

Ecclesiastical Commission. Report.

Education, Board of. Education report and statistics. Health of the school child. Memorandum on Board of Education estimates.

Electricity Commission. Annual report. Engineering and financial statistics. Generation of electricity.

Foreign Office. Suez Canal: annual return of shipping and tonnage.

Forestry Commission. Annual report.

Friendly Societies, Registry of. Reports of the Chief Registrar. Report of the Industrial Assurance Commissioner.

General Register Office. Weekly return of births and deaths. Quarterly return of births, deaths and marriages. Registrar-General's statistical review.

Health, Ministry of. Accounts of the National Health Insurance Fund. Annual report of the Ministry of Health. Annual report on alkali works. Costing returns. Local government financial statistics. Persons in receipt of poor relief. Rates and rateable values in England and Wales. State of the public health. Welfare of the blind, report.

Herring Industry Board. Annual report.

Home Office. Aliens order: return of Alien passengers. Aliens (naturalisation) return. Criminal statistics. Report of Chief Inspector of Factories and Workshops. Licensing statistics. Offences relating to motor vehicles. Police (Counties and Boroughs), reports of H.M. Inspectors. Report of the Commissioner of Police for the Metropolis. Prisons and convict prisons. Race-course Betting Control Board report. Road accidents involving personal injury. Workmen's compensation statistics.

Imperial Economic Committee. Dairy produce supplies. Fruit supplies. Supplies of canned and dried fruit. Wool production and trade.

(a) United Kingdom and its several Divisions—*Contd.*

United Kingdom—*Contd.*

Imperial Institute. Mineral industry of the British Empire and foreign countries statistical summary.

India Office. Home accounts. Statistical abstract for British India. Return of the budget of the Governor-General of India in Council.

Industrial Health Research Board. Reports.

Inland Revenue, Board of. Report of Commissioners.

Labour, Ministry of. Abstract of labour statistics. Annual report of the Ministry of Labour. Juvenile employment (London) reports. Local unemployment index. Ministry of Labour gazette. Report of the Unemployment Assistance Board.

Lord Chancellor's Department. Civil judicial statistics.

Medical Research Council. Annual report. Special report series.

Meteorological Office. Annual Report of the Director. Monthly weather report, annual summary.

Mines Department. Annual report of Secretary for Mines. Deaths from accidents in mines. Electrical Inspector of Mines, report. List of mines. Miners' welfare fund, report. Safety in Mines Research Board, report.

Mint, Royal. Annual report of the Deputy Master and Comptroller.

National Debt Commissioners. Local loans fund, accounts, National Health insurance fund and Unemployment insurance fund, account of securities held. Post Office savings banks, accounts. Savings banks and friendly societies, annual account. Trustee savings banks, annual report of the Inspection Committee.

National Insurance Audit Department. Report.

Overseas Trade, Department of. Reports by H.M. Trade Commissioners.

Patent Office. Report of the Comptroller-General.

Pensions, Ministry of. Annual report.

Permanent Consultative Committee on Official Statistics. Guide to current official statistics.

Post Office. P.O. Commercial accounts. British Broadcasting Corporation annual report.

Public Trustee Office. General report.

Public Works Loan Board. Annual report.

Queen Anne's Bounty Office. Annual report.

Scientific and Industrial Research, Department of. Annual report. Forests Products Research Board, report. Fuel Research Board, report.

Trade, Board of. Accounts relating to trade and navigation [monthly]. Annual statement of trade. Bankruptcy. Board of Trade journal. Companies. Controller of the Clearing Office, report. Foreign trade and commerce [quarterly]. Gas undertakings. Navigation and shipping. Pilotage return. Shipping casualties and deaths on vessels. Statistical abstract for the British Empire. Statistical abstract for the United Kingdom. Survey of industrial development. Weights and measures.

Transport, Ministry of. London and Home Counties Traffic Advisory Committee, annual report. Railway accidents. Railway companies (staff) return. Railway Rates Tribunal, annual report. Railway returns. Road and Rail Traffic Act: annual reports of the licensing authorities. Return of road accidents. Road Fund, report on administration of. Tramways and light railways (street and road) and trolley vehicle undertakings.

Treasury. Appropriation accounts: Civil service, revenue departments. Consolidated fund, abstract account. Finance accounts. Financial statement. National debt return. National Radium Trust and Radium Commission, annual report. Public departments, gross and net cost. Public social services, return of expenditure. Public income and expenditure. Trading accounts and balance sheets.

University Grants Committee. Returns from universities and university colleges in receipt of Treasury grant.

War Office. Army appropriation account. General annual report of the British Army. Health of the army. Territorial army finances. War Office Library, annual supplement to subject index.

(a) United Kingdom and its several Divisions—*Contd.*

United Kingdom—*Contd.*

Municipal and other local returns.

LONDON COUNTY COUNCIL. Annual report. L.C.C. gazette. London statistics. Statistical abstract.

METROPOLITAN BOROUGHS. Accounts: Battersea, Islington. Medical Officer of Health, report: Paddington.

MUNICIPAL BOROUGHS. Accounts: Birmingham, Carlisle, Chester, Ipswich, Leicester, Liverpool, Manchester, Nottingham, Southgate. Medical Officer of Health, reports: Birmingham, Liverpool, Manchester, Wolverhampton.

Scotland—

Agriculture, Department of. Agricultural returns. Agricultural statistics. Preliminary returns—acreage. Produce of crops. Report.

Control, General Board of. Annual report.

Education Department, Scottish. Annual reports, combined volume.

Fishery Board for Scotland. Annual report. Statistical tables.

Health, Department of. Annual report. Central Midwives Board, report. Report on incapacitating sickness in the insured population.

Prisons Department. Annual report. Civil judicial statistics. Criminal statistics.

Registrar-General. Annual report. Births, deaths and marriages: weekly, monthly, and quarterly returns.

Scottish Office. Constabulary, report of H.M. Inspector. Local taxation returns.

ABERDEEN. Report of the Medical Officer of Health.

EDINBURGH. Municipal accounts.

GLASGOW. Report of the Medical Officer of Health.

Northern Ireland—

Commerce, Ministry of. Electricity Supply Acts, annual report. Industrial Assurance Commissioner, annual report.

Education, Ministry of. Report.

Finance, Ministry of. Registrar-General's review of vital statistics. Quarterly return of births, deaths, and marriages. Ulster year-book.

Home Affairs, Ministry of. Local taxation returns.

Miscellaneous Publications.

Accountant. Accountants' magazine. Agricultural Economics Society, journal of proceedings. Agricultural Economics Research Institute, Oxford: the agricultural register. Alliance news. Alliance year book and temperance reformers' handbook. Anglo-Swedish review. Annals of eugenics. Auctioneers' and Estate Agents' Institute, Journal.

Banking almanack. Banker. Bankers' magazine. Bank of England, statistical summary. Barclays Bank monthly review. Barclays Bank (Dominion and overseas) monthly trade cables. Biometrika. Brewers' almanack and wine and spirit trade annual. British Association for the Advancement of Science, report of the annual meeting. British Iron and Steel Federation: statistical bulletin [monthly], statistics [annual]. British Library of Political and Economic Science monthly list. British Waterworks Association, official circular. Broomhall's corn trade year-book. Building industries survey. Building societies year-book.

Chamber of Commerce journal. Chamber of Shipping, annual report. Chartered Institute of Secretaries, proceedings, etc. Chartered Surveyors' Institution, journal, list of Fellows. Colliery guardian. Commercial world. Co-operative Union Ltd. Annual Congress report. Corporate accountant. Corporation of Foreign Bondholders, annual report.

Daily Herald monthly new capital digest. Daily Mail year-book. Dalgety and Co., annual review.

(a) United Kingdom and its several Divisions—*Contd.*

Miscellaneous Publications—Contd.

East India Association journal. Economica. Economic history. Economic journal. Economist. Eugenics review.

Faculty of Actuaries, transactions. Financial review of reviews. Fireman.

Geographical journal.

Health and empire. Horse owners' reference book. Hospitals year-book.

Incorporated Association of Rating and Valuation Officers, journal. Institute of Actuaries, journal, year-book. Institute of Actuaries Students' Society, journal. Institute of Bankers, journal. Institute of Chartered Accountants, list of members. Institution of Civil Engineers, journal, list of members. International cotton bulletin. Iron and Steel Institute, journal.

Jacks (W. & Co.) trade barometer.

King Edward's Hospital Fund: Annual report, statistical summary.

Land and liberty. Light and lighting. Liverpool Cotton Association, annual and weekly circulars. Lloyds Bank monthly review. Lloyd's Register: annual report, shipbuilding returns, wreck returns. London and Cambridge Economic Service: monthly bulletin, and special memoranda. London Bankers' Clearing House, annual statement. London Passenger Transport Board, annual report and accounts.

Mallett's weekly wool chart. Manchester guardian commercial. Manchester school. Manchester Statistical Society, transactions. Mersey Docks and Harbour Board, annual report. Metropolitan Water Board, annual report. Midland Bank monthly review. Mining Association of Great Britain, Statistical review of the coal industry. Municipal year-book.

National Association for Prevention of Tuberculosis: transactions, report of Council. Nature.

Peabody Donation Fund, report of Governors. People's year-book. Pixley and Abell's circular. Planning. Population. Post magazine: Post magazine almanack. Public administration. Publishers' circular.

Quarterly journal of mathematics. Quin's metal handbook and statistics.

Registered accountant. Review of base metal conditions. Review of economic studies. Rothamsted Experimental Station: annual report. Royal Agricultural Society of England, journal. Royal College of Physicians of London, list of Fellows, etc. Royal College of Surgeons of England, Calendar. Royal Institution, proceedings. Royal Meteorological Society, journal, phenological report. Royal Sanitary Institute, journal. Royal Society of Arts, journal. Royal Society of Edinburgh, proceedings, transactions.

Samuel Montagu & Co., Weekly letter, Annual bullion letter, Scottish Chartered Accountants, official directory. Secretary. Secretaries' Association, year-book. Seyd (R.E.), statistics of failures. Signal. Society of Motor Manufacturers: the Motor industry of Great Britain. Society of Incorporated Accountants and Auditors, year-book. Sociological review. South Wales coal annual. Statesman's year-book. Statist. Stock exchange gazette. Stock exchange year-book.

Tattersall's cotton trade review [annual]. Times. Times literary supplement. Times trade and engineering supplement. Tin.

United empire. University calendars: University of London; University College, London; Manchester University; University College of Wales; Queen's University, Belfast.

Vacher's parliamentary companion.

Wallis' index cotton circular. Weddel & Co., Annual review of the imported dairy produce trade. Westminster Bank review. Whitaker's almanack. Willing's press guide. Who's who.

Year-book of scientific and learned societies.

(b) British Empire.

Australia—

Bureau of Census and Statistics. Australian demography. Finance. Labour report. Monthly review of business statistics. Official year book.

(b) **British Empire**—*Contd.*

Australia—*Contd.*

Oversea trade. Pocket compendium of Australian statistics. Production. Quarterly summary of Australian statistics. Transport and communication.
Commonwealth Grants Commission. Report.
Department of Health. Health.
Commonwealth Bank of Australia. Statistical bulletin.
Economic record.

NEW SOUTH WALES—
Auditor General. Report.
Bureau of Statistics and Economics. Official year book. Statesman's year book. Statistical bulletin. Statistical register.
Department of Railways. Report of the Commissioner.
Industrial Registrar. Trade unions.
Public Works Department. Report.

QUEENSLAND—
Government Statistician's Office. Agricultural and dairying production. Live stock and pastoral production. Queensland year book. Statistics of the State of Queensland.

SOUTH AUSTRALIA—
Public Library, Museum and Art Gallery. Annual report.
Statistical Office. Statesman's pocket year book. Statistical register.

TASMANIA—
Bureau of Census and Statistics, Tasmania Branch. Pocket year book. Statistics of the State of Tasmania.
Report on Government Railways and Ferry Service.

VICTORIA—
Office of the Government Statist. Victoria year book. Friendly societies, report.
Public Library, Museum and National Gallery. Report of the Trustees.

WESTERN AUSTRALIA—
Department of Mines. Report.
Government Statistician's Department. Pocket year book. Quarterly statistical abstract. Statistical register.
Registrar of Friendly Societies. Report of proceedings.

British West Indies—

Tropical agriculture.

Canada—

Department of Agriculture. Report of the Veterinary Director General.
Department of Finance. Public accounts.
Department of Justice. Annual report of the Superintendent of Penitentiaries.
Department of Labour. Labour gazette. Prices in Canada and other countries. Wages and hours of labour.
Department of Public Works. Report of the Minister of Public Works.
Dominion Bureau of Statistics. Annual survey of education. Automobile accidents. Canada year book. Chemicals and allied products. Coal statistics. Fisheries statistics. Iron and steel industry. Manufactures of non-ferrous metals. Manufacturing industries of Canada. Mineral production. Monthly review of business statistics. Statistics of dairy factories. Statistics of steam railways. Trade of Canada [fiscal year, calendar year, quarterly returns]. Vital statistics.

(b) **British Empire**—*Contd.*

Canada—*Contd.*

ALBERTA. *Department of Public Health.* Annual report of the Vital Statistics Branch.
QUEBEC (PROVINCE). Statistical year book.
Bank of Nova Scotia; Monthly review.
Canadian Bank of Commerce, commercial letter; annual statement.
Royal Bank of Canada, monthly letters; annual report.

Ceylon—

Administrative reports. Blue book. Railways (Government) report. Papers laid before State Council. Vital statistics.
Ceylon economic journal.

Éire—

Currency Commission. Quarterly statistical bulletin.
Department of Agriculture. Journal.
Department of Industry and Commerce. Irish trade journal. Statistical abstract. Trade and shipping statistics [annual]. Trade statistics. [monthly].
Department of Local Government and Public Health. Annual report of the Registrar-General. Quarterly return of the marriages, births and deaths.
Irish Agricultural Organisation Society Ltd. Annual report.
Statistical and Social Inquiry Society of Ireland, Journal.

Federated Malay States—

F.M.S. government gazette; Manual of statistics. Report of the Customs and Excise Department.

India—

Department of Commercial Intelligence and Statistics. Agricultural statistics. Indian coal statistics. Monthly statistics of cotton spinning and weaving. Monthly statistics of production in certain selected industries. Review of the trade of India. Sea-borne trade, annual statement of. Sea-borne trade and navigation [monthly.] Sea-borne trade and navigation for the calendar year. Statistical abstract for British India. Statistical tables relating to banks. Trade at stations adjacent to the land frontier routes.
Department of Industries and Labour. Annual report of Chief Inspector of Mines.
Meteorological Office. Memoirs. Scientific notes.
ASSAM. Administration report.
BENGAL. Administration report. Report on maritime trade.
BOMBAY. Labour gazette.
PUNJAB. Memoirs of the Irrigation Research Institute. Public health report.
Indian accountant.
Indian journal of economics.
Punjab Board of Economic Enquiry, publications.
Sankhyā, Indian journal of statistics.

Jamaica—

Vital statistics.

Malaya—

Average prices, trade, exchange, currency, cost of living. Foreign imports and exports [annual]. Malayan statistics.

Mauritius—

Blue book.

(b) British Empire—*Contd.*

New Zealand—

Census and Statistics Office. Agricultural and pastoral production. Factory and building production. Friendly societies and trades unions. Insurance statistics. Justice statistics. Local authorities' handbook. Monthly abstract of statistics. New Zealand official year-book. Population and buildings. Statistics of incomes and income tax. Statistical report on prices, wages . . . banking, building societies, commercial afforestation, incomes and income tax. Trade and shipping. Vital statistics.

Auckland Chamber of Commerce, journal.

Canterbury Chamber of Commerce, bulletin.

Royal Society of New Zealand, transactions and proceedings.

Wellington Harbour Board, accounts.

Nigeria—

Nigeria trade summary.

Southern Rhodesia—

Department of Statistics. Annual statement of the trade. Economic and statistical bulletin. Official year book of the Colony. Report on the insurance statistics.

Rhodesia Chamber of Mines : annual report, monthly returns.

Uganda Protectorate—

Blue book.

Union of South Africa—

Department of Customs and Excise. Annual statement of the trade and shipping. Trade of the Union of South Africa [quarterly].

Department of Mines. Annual report of the Government Mining Engineer.

Office of Census and Statistics. Census of industrial establishments. Official year book. Statistics of migration. Report on the vital statistics.

Cape of Good Hope. Ordinances.

Natal. Fisheries report.

South African journal of economics.

Transvaal Chamber of Mines : annual report, and monthly analysis.

(c) Foreign Countries.

Argentine Republic—

Banco Central de la Republica Argentina. Annual report.

Dirección General de Estadistica. Anuario del comercio exterior. El comercio exterior.

Buenos Aires. Rivista de estadistica municipal.

Buenos Aires (Province). Boletin la Dirección General de Estadistica.

Revista de ciencias economicas.

Austria—

Bundesamt für Statistik. Statistische Nachrichten. Statistisches Handbuch.

Bundesministerium fur Handel und Verkehr. Jahresheft der Statistik des Aussenhandels Österreichs. Statistik des Aussenhandels Österreichs.

Bundesministerium fur Land- und Forlwirtschaft. Statistik der Ernte.

Vienna. *Statistisches Amt der Stadt.* Mitteilungen aus Statistik. Statistisches Jahrbuch. Statistisches Taschenbuch.

Monatsberichte des Instituts für Konjunkturforschung.

(c) **Foreign Countries**—*Contd.*

Belgium—

Ministère de l'Agriculture. Publications de l'Office de Statistique Agricole.
Ministère des Finances. Bulletin mensuel du commerce [December issues].
Ministère du Travail et de la Prevoyance Sociale. Rapport relatif à l'execution de la loi sur la réparation des dommages résultant des accidents du travail. Revue du travail.
Statistique Générale. Annuaire statistique. Bulletin trimestriel. Statistique des accidents de roulage et de la circulation.
Bulletin de l'Institut de Recherches Économiques.

Brazil—

Departamento Nacional da Industria e Commercio. Boletim.
Directoria de Estatistica Economica e Financeira. Banking. Estatisticas economicas. Foreign trade of Brazil, summary by merchandise.
Ministerio da Agricultura. Revista de economia e estatistica.
Ministerio do Trabalho Industria e Commercio. Boletim.

Bulgaria—

Direction Générale de la Statistique. Annuaire statistique. Bulletin mensuel. Mouvement de la population. Revue de la statistique générale. Statistique agricole. Statistique du commerce exterieur. Statistique coopérative. Statistique criminelle. Statistique de l'enseignement.
State University of Sofia. Publications of the Statistical Institute for Economic Research.

Chile—

Dirección General de Estadistica. Estadistica Chilena [monthly].

China—

Chinese Maritime Customs. List of lighthouses, light-vessels, etc. Monthly returns of the foreign trade. Trade of China [annual].
National Tariff Commission. Annual report of Shanghai commodity prices. Index numbers of wholesale prices.
Ministry of Communications. Report on the Chinese Post Office.
Nankai Institute of Economics : Nankai social and economic quarterly.

Cuba—

Seccion de Estadistica. Comercio exterior.

Czechoslovakia—

Office de Statistique. Annuaire statistique. Monthly summary of foreign trade. Rapports de l'Office de Statistique. Rapports sur les prix. Revue statistique Tchécoslovaque.
Statistique Tchécoslovaque [including annual returns on—agriculture, education, movement of population, public finance, trade, etc.].
PRAGUE. Annuaire statistique. Bulletin mensuel.

Denmark—

Det Statistiske Departement. Danmarks Handelsflaade og Skibsfart. Danmarks . . . Retspleje. Danmarks Varei ndførsel og Udførsel. Statistisk Aarbog. Statistiske Efterretninger.
Statistiske Meddelelser [including annual returns on—agriculture and live-stock, electrical undertakings, housing and rents, Municipal finance, prices, production, taxation, etc.].
Vareomsaetning med Udlandet [monthly].
COPENHAGEN. *Statistiske Kontor.* Statistisk Aarbog.
Sundhetsvæsenet, Aarsberetning.
Bulletin hebdomadaire de statistique démographique.
Nationaløkonomisk Tidsskrift.

(c) Foreign Counties—*Contd.*

Egypt—

Département de la Statistique Générale. Annuaire statistique. Annual statement of the foreign trade. Births, deaths and infectious diseases [weekly]. Monthly agricultural and economic statistics. Monthly summary of the foreign trade. Return of shipping, cargo, and passenger traffic in the Egyptian ports and Suez Canal transits [annual, and Quarterly]. Statistique scolaire. Vital statistics.
Commission de la Dette Publique. Compte rendu des travaux de la Commission.
Ministry of Communications. Report of the postal savings bank service.

L'Egypte contemporaine.

Estonia—

Bureau Central de Statistique. Annuaire de la statistique agricole. Commerce exterieur. Recueil mensuel du Bureau Central de Statistique.
Eesti Pank annual report.
Institute of Economic Research, weekly bulletin. Konjunktuur.

Finland—

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Reichsgesundheitsamt. Reichs-Gesundheitsblatt.

Statistisches Reichsamt. Monatliche Nachweise über den auswärtigen Handel Deutschlands.

Statistik des Deutschen Reichs [including annual reports on—Consumption of excisable articles, Crime, Movement of Population, Railway traffic (goods), Sickness insurance, Trade and Navigation, etc.].

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Institut fur Konjunkturforschung: Halbjahrsberichte zur Wirtschaftslage, Statistik des In- und Auslands, Vierteljahrsheft zur Wirtschaftsforschung. Weekly Report, Wochenbericht.
Statistisches Jahrbuch deutscher Gemeinden.
Weltwirtschaftliches Archiv.
Wirtschaftsdienst.
Zeitschrift für die gesamte Versicherungs-Wissenschaft.

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Office Central Royal Hongrois de Statistique. Annuaire statistique hongrois. Bulletin statistique trimestriel.

Publications statistiques hongroises [including annual reports on—Education, Movement of Population, Trade, etc.].

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Journal de la Société Hongroise de Statistique.
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Iceland—

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Italy—

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Latvia—

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RIGA. Annuaire statistique de la ville.

Luxemburg, Grand Duchy—

Office de Statistique. Aperçu Statistique. Bulletin trimestriel.

Mexico—

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Boletin de la Sociedad Mexicana de Geografia y Estadística.

Morocco—

Bulletin économique du Maroc.

Mozambique—

Repartição de Estatística. Anuario estatistico. Bulletin économique et statistique. Estatistica do comércio e navegação.

Netherlands—

Centraal Bureau voor de Statistiek. Crimineele statistiek, Gevangenisstatistiek, Statistiek van de toepassing der kinderwetten. Jaarcijfers voor Nederland. Jaarstatistiek van den in, uit- en doorvoer. Justitieele statistiek en Faillissementsstatistiek. Maandstatistiek van den in-, uit-, en doorvoer. Statistiek van de scheepvaart op het buitenland. Nederlandsche Conjunctuur. Maandschrift van het Centraal Bureau voor de Statistiek.
AMSTERDAM. *Bureau de Statistique.* Annuaire statistique. Bulletin mensuel.

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Centraal Kantoor voor de Statistiek. Education statistics. Statistical abstract. The export crops.

Norway—

Committee for Whaling Statistics. International whaling statistics.
Det Statistiske Centralbyrå. Månedsopgaver over vareomsetningen med utlandet.
Norges Offisielle Statistikk [including annual reports on—agriculture and live-stock, assurance, crime, finance, fisheries, industrial production, mineral industry, milk industry, postal and telegraph services, public health, railways, trade, veterinary service, etc.].
Statistisk årbok. Statistisk økonomisk oversikt. Statistiske meddelelser.
OSLO. Årsberetning. Beretning fra Oslo helseråd. Statistisk årbog. Statistisk manedskrift.

Peru—

Departamento de Estadistica General de Aduanas. Boletin mensual del comercio especial. Anuario del comercio exterior.
Dirección Nacional de Estadistica. Extracto estadistica.
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Philippine Islands—

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Poland—

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Statistique du travail.
Baltic Countries. Ekonomika.
Polish Institute for Economic Research : koniunktura gospodarcza. Monthly statistical tables.

Portugal—

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Rumania—

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Russia—

Chief Customs Directorate. Statistical review of the foreign trade. [Monthly.]
Russkyt Ekonomichesky Svornik (Russian economic journal : published by Prof. Prokopovich's Economic Committee, at Prague).

Siam—

Statistical year-book.

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Kommerskollegium. Kommersiella meddelanden. Sveriges in-och utförsel.
Riksgäldskontoret. Svenska statens tillgångar och schulder.
Socialstyrelsen. Sociala meddelanden.
Statistiska Centralbyrån. Statistisk årsbok. Statistiska meddelanden [including Järnvägssatatistiska meddelanden. Uppgifter om bankerna].

Sveriges officiella statistik [including annual returns relating to—agriculture and live-stock, assurance, banking, co-operative societies, crime, excise, finance (state and municipal), fisheries, forests, industry, labour and wages, lunacy, mines, pensions, poor relief, population, postal services, public health, health of army and navy, railways, savings banks, trade and shipping, veterinary service, water-power, etc.].

Sveriges Riksbank. Årsbok.
STOCKHOLM. *Statistiska Kontor.* Statistisk årsbok.
Economisk tidskrift.
Skandinaviska Kreditaktiebolaget, Quarterly report.
Svenska Handelsbanken, Index.
Swedish economic review.

Switzerland—

Bureau Fédéral des Assurances. Les entreprises d'assurances privées.
Bureau Fédéral de Statistique. Annuaire statistique. Contributions à la statistique Suisse.

Statistiques de la Suisse [including annual returns relating to: agricultural statistics, assurance societies, crime, finance, forestry, live-stock, vital statistics].

Département Fédéral de l'Economie Publique. La vie économique. Die Volkswirtschaft.
Direction Générale des Douanes Fédérales. Statistique annuelle du commerce exterieur. Statistique mensuelle du commerce exterieur. Statistique du commerce Suisse, rapport annuel.
BERN. Bevölkerung und Wirtschaft der Stadt Bern.
ZURICH. Statistisches Jahrbuch. Zürcher statistische Nachrichten.

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Turkey—

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Central Statistical Board. Annual report.
Census, Bureau of the. Birth, stillbirth and infant mortality statistics. Cotton production. Cotton production and distribution. Financial statistics of cities. Mortality statistics. Vital statistics—special reports.
Children's Bureau. Annual reports. Bulletins.
Currency, Comptroller of the. Annual report.
Education, Office of. Biennial survey of education. Bulletin. School life.
Federal Reserve Board. Annual report. Federal Reserve bulletin.
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Library of Congress. Annual report of the Librarian.
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Panama Canal, Office of the. Annual report of the Governor. Panama Canal record.
Public Health Service. Public health reports.
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CALIFORNIA. Department of Industrial Relations, Report. Division of Fish and Game, Fish bulletins.
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Actuarial Society of America, Transactions. American Academy of Political and Social Science, annals. American Bureau of Metal Statistics, year-book. American economic review. American Institute of Actuaries, The record. American Petroleum Institute, bulletin. American Philosophical Society, proceedings, year book. American Statistical Association, bulletin, journal. Annals of mathematical statistics.
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Bank for International Settlements—

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Agricultural situation. International review of agriculture. International year-book of agricultural statistics. International year-book of agricultural legislation. International year-book of forestry statistics.

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International Statistical Institute—

Bulletin de l'Institut International de Statistique. Revue de l'Institut International de Statistique [quarterly].

League of Nations—

Official journal.

Economic and Financial Section. Balances of payments. Commercial banks. International trade statistics. Monthly bulletin of statistics. Review of world trade. Statistical year-book of the League of Nations. World economic survey. World production and prices.

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